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"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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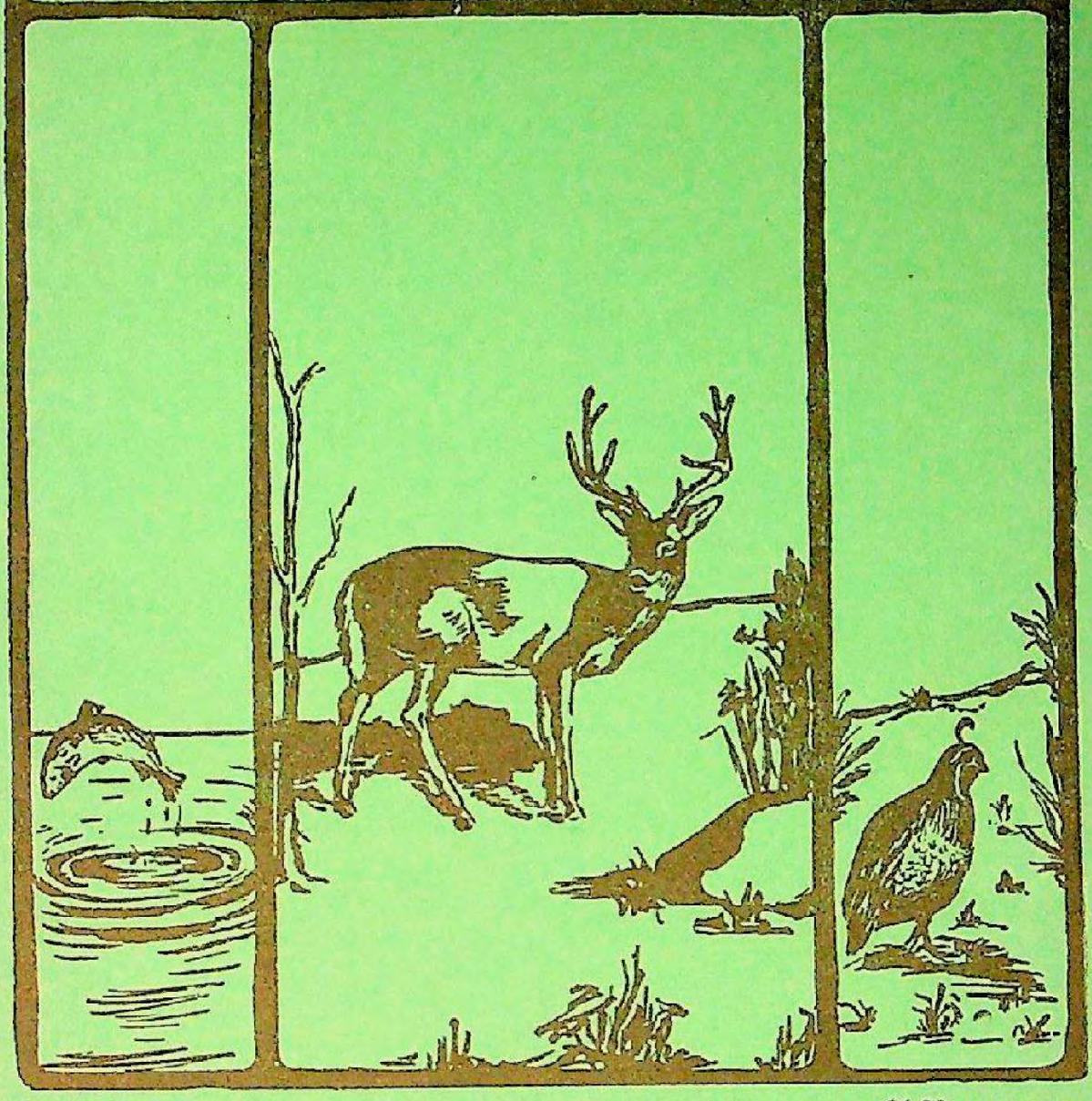

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SMOKED, SALTED AND DRIED SEA FOODS OF CALIFORNIA*

By RICHARD S. CROKER

What would a delicatessen store be without its display of plain and fancy smoked, dried and pickled fish? As far as most of us are concerned it wouldn't be a real delicatessen. Very few of us can resist pausing to gaze at the tempting array of finnan haddie, bloaters,

* Contribution No. 141 from the California State Fisheries Laboratory, December, 1935.

rollmops, codfish, kippered salmon, salted mackerel—all of them world famous and world popular.

And who has visited Chinatown and failed to see the variety of dried sea foods displayed in nearly every store? A list of the sea foods that the Chinese dry sounds like a roll call of the ocean: rockfish, kingfish, sole, flounder, pompano, tai, sea-horse, squid, large and tiny shrimps, abalone, oyster, octopus, baby herring, shark fins, sea-cucumber, sea-bass sounds, and many strange things hard to guess.

Most of the cured fish sold in the delicatessen and Oriental stores in California is imported from outside the State. Norway, Germany, Netherlands, England, France, Japan, and China all send us a variety of pickled, dried and smoked sea foods. Nova Scotia contributes the finnan haddie; New England and the State of Washington send dry-salted codfish and a variety of smoked fish. On the other hand, the several California packing plants produce considerable quantities of dried, pickled, hard-salted, smoked, and mild-cured fish, a great deal of which is exported or sent east.

The market for cured fish is universal although not fully developed. For one thing, many people who partake of light beverages like salted fish of one sort or another to eat with the drink. The salty fish induces thirst and makes it possible to drink more. The prohibition laws cut into the salt-cured fish trade rather heavily. In the old days nearly every saloon kept a platter of bloaters on the bar for the patrons to nibble, and consequently drink more beer. During prohibition days the speakeasies specialized on gin and other hard liquors that provoke their own thirst, so the fish were not necessary. Since repeal, however, the market for cured fish has improved tremendously, and salted and pickled fish have again made their appearance on bars throughout the country.

Most people of English or continental extraction are fond of cured fish, and many families serve it at one meal nearly every day. Oriental epicures prepare many wonderful and awe-inspiring dishes from dried sea food. The Jewish people are far and away the largest consumers of smoked fish in this country, having learned to appreciate the quality of this fine sea food long ago. Scarcely a day goes by that the average Jewish family does not have smoked fish for at least one meal. Although the average American has never been very fond of salted fish, finnan haddie and similar smoked and kippered fish are becoming increasingly popular with him.

The cured fish industry of California is really quite large, although it does not compare either in magnitude or fame with the canned fish industry. Of all the kinds of cured sea foods produced in this State, the best known and most important are mild-cured salmon, smoked sablefish and salted codfish.

Mild Cured Salmon

The mild-curing of salmon in California commenced on the Sacramento River in 1900 and at Monterey about 1901. At present there are mild-curing stations at several places along the northern California coast and on the Sacramento-San Joaquin River.

Mild-curing is a distinctive process to prepare fish for a certain type of smoking. Formerly, most of the mild-cured salmon produced

in California was shipped to the large cities of the eastern United States for sale to the Jewish and foreign population. During the last few years the production has been on a smaller scale than formerly, due chiefly to a scarcity of large salmon. The San Francisco and Los Angeles markets absorb the greater part of the reduced output. The packers of Oregon, Washington and Alaska now supply most of the eastern demand.

The Sacramento River was long the center of the mild-curing industry. The large runs of salmon in the river supplied a number of active curing plants years ago. The peak seasons were in 1909 and 1910. But the salmon have become scarce in the river and there are but few small stations at present, located at Pittsburg and Stockton. The 1935 pack of 440 tierces was the largest since 1927.

Before and shortly after the war, mild-curing was the most important fisheries industry at Monterey. Since about 1920 the sal-

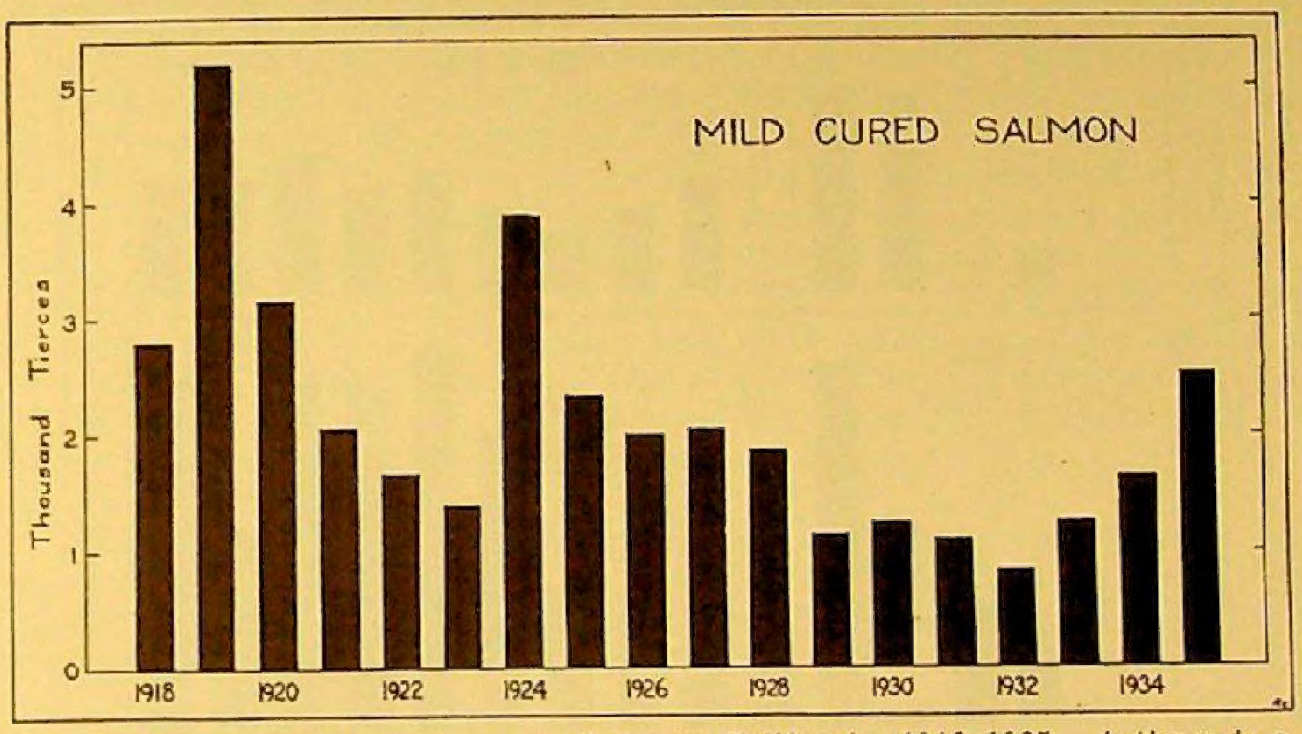

FIG. 1. Production of mild-cured salmon in California, 1918–1935. A tierce is a barrel containing from 775 to 850 pounds of cured fish, averaging about 800 pounds. Approximately 1100 pounds of round salmon are required for an 800-pound tierce.

mon fishery of that port has declined markedly because of a scarcity of fish, and the mild-cure production at Monterey has dwindled to practically nothing. In 1933, about 120 tierces were packed at Monterey, the first appreciable production since 1925.

Some years ago it was discovered that salmon could be taken by trolling off the coast of northern California. The fish were large and otherwise excellent for mild-curing. Stations sprang up at several points and the production of mild-cured salmon in the coastal area soon outstripped that of the river and Monterey districts. Although the mild-cure industry of California is not as important as it was some years ago (see Fig. 1) the output of the northern coastal area has held up quite well. The 1935 season was the best in ten years, both on the northern coast and on the river. The several coastal stations operating in recent years are located at Eureka, Shelter Cove, Fort Bragg, Bodega Bay and Point Reyes.

Although salmon is the fish most utilized for mild-curing, small amounts of shad are cured in the river district from time to time. The highly particular Jewish trade absorbs this product.

To describe the process of mild-curing in a few words, we would do best to quote Scofield (1925) as follows: "The salmon is gutted, headed, and the sides split from the backbone. The 'sides' are then scraped or 'slimed' and placed in a chilling bath of salted iced water. They are then drained, given a light coating of dry salt, packed in barrels or 'tierces', mild brine added, and the tierce kept in cold storage for a few weeks. Sides are then taken out, graded and 'repacked' in tierces, fresh brine added and the tierces shipped in refrigerator cars. Sides can then be removed, washed, given a light smoke and sold to the retail trade. The 'curing' is accomplished in the first brine (before the repack), the mild cure in brine giving the name to the process."

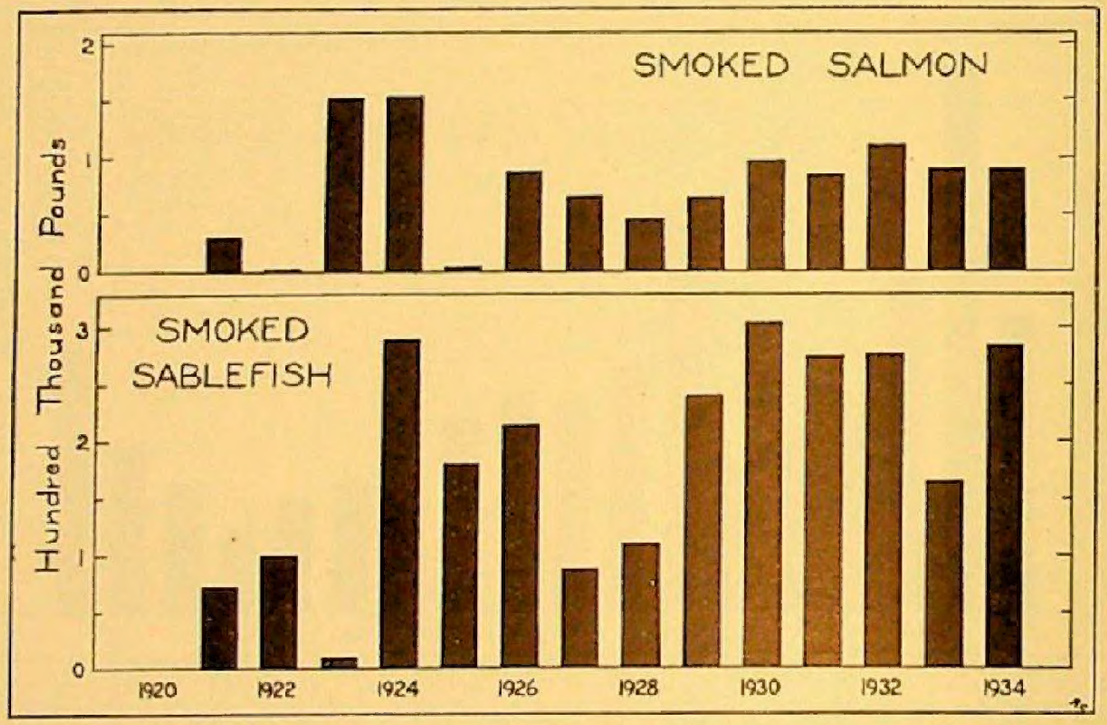

FIG. 2. Production of smoked salmon and smoked sablefish or "black cod" at San Francisco, 1920–1934.

Fresh salmon of 16 pounds or more, preferably king salmon with red flesh, are used. Most of the production consists of king salmon, but a few tierces of silver salmon are packed every year. The tierce is a barrel holding 775 to 850 pounds of cured fish. Mild-cured salmon will keep 30 to 40 days after smoking if held in refrigeration although it is best when freshly smoked. The curing is done at strategically located shore stations or barges, and the smoking in the city where the product is to be retailed.

Smoked Fish

Smoked sablefish, variously known as smoked, kippered or barbecued sablefish or black cod, is the most important smoked fish product prepared in California. Smoked sablefish is of relatively recent origin, but its popularity is growing rapidly as its quality becomes better known.

The production of this article has increased from nothing in 1920 to a peak of over 300,000 pounds in 1930. (See Fig. 2.) The increasing popularity of kippered black cod is cutting into the sale of finnan haddie to a considerable extent on the Pacific Coast.

No salmon was smoked in California for several years prior to 1921, but now smoked salmon is second only to sablefish, with an average annual production of 80,000 pounds. (See Fig. 2.)

The entire output of California smoked salmon and black cod is produced at San Francisco. The sablefish are shipped frozen from Eureka and Seattle. The salmon are either local fresh fish or Alaska frozen fish. The frozen fish are thawed out immediately before the curing process is started.

Smoked, kippered or barbecued black cod (sablefish) and salmon are prepared in exactly the same manner as follows: King salmon of a weight exceeding 15 pounds and sablefish of 5 to 20 pounds are most desirable. The fish are split and the halves cut into pieces weighing 1 to 1½ pounds. The pieces are soaked in a strong brine solution for 1½ to 2½ hours. Then the pieces are placed on trays in the smoke room over a wood fire augmented by gas flame. After 8 hours the fire is drawn but the pieces of fish remain over the smoke for 2 hours more. The smoked fish are packed in small wooden boxes. Fish prepared in this way will keep about 2 months in refrigeration.

The product known as "spring salmon" is prepared by the use of cold smoke process. The fish are split and cleaned as for mild-curing, given a brief brine bath and subjected to cold hardwood smoke for 24 hours. The sides, or halves, of the large king salmon used are smoked entire. This product is not salable more than 6 or 7 days after smoking.

Many other species of fish are also smoked in California. Bismarck herrings, often sold as bloaters, are produced at San Francisco. For preparing this product, Alaska brine herrings are soaked in fresh water until there is no more than enough salt left to keep them from spoiling. Then they are given a short smoke, after which they are ready for sale. Sometimes it is necessary to use a harmless coloring matter to give them the desirable golden-brown tint.

Shad from the Sacramento River and local sardines are sometimes kippered at San Francisco. They are gutted and beheaded, and the bodies are smoked entire.

In recent years a smokehouse in Long Beach has produced kippered mackerel from local and Newport-caught fish. The mackerel, large ones preferably, are gutted and beheaded and then thoroughly washed in fresh water and scrubbed with a rotary brush. They are then soaked overnight in brine. The soaking draws out the blood, which is removed in a second washing. The fish are then hung up by their tails in the smokehouse and subjected to the cold smoke of a hardwood fire for 20 hours. Each mackerel is then wrapped in an individual cellophane wrapper. The fish will keep for weeks in cold storage. The best market for the kippered mackerel is in the San Francisco Bay region where it is usually cool, as the product spoils rapidly in a warm climate. The cellophane wrapper has proved attractive to the American housewife. At this plant, mackerel smoked in the same manner are skinned and boned and packed in glass jars with either olive oil or vinegar.

During, and for a short time after, the World War—the period of the "eat more fish and save meat" campaigns—considerable quantities of albacore, bonito, tuna, yellowtail, and other fish were smoked at San Pedro and San Diego. From a peak of 130,000 pounds in 1920, the smoked fish production of southern California dwindled to nothing in 1924. Aside from kippered mackerel, there has been no wholesale smoking of fresh fish in southern California since 1923. The smokehouses in Los Angeles process principally frozen whitefish and other fish from the east as well as mild-cured salmon and salted herring.

There are numbers of small plants in southern California, however, that smoke fish for retail trade. Nearly every seaside town has one or more of these smokehouses. The operators themselves sell their products at stalls on the piers at Long Beach, Redondo, Hermosa and other towns and at roadside stands along the coast highway. The Newport Beach producers, three or four in number, sell their wares from skiffs hauled on the beach in the picturesque open-air fish market unique to that town. The fish most often prepared at the southern California retail smokehouses are mackerel, barracuda, bonito, sharks, marlin swordfish, and yellowtail. At Newport Beach smoked sablefish, locally known as "deep sea trout," is also produced. Each operator has his own method of preparation, jealously kept secret. Smoking times for mackerel, for instance, vary from 7 to 24 hours with the smokehouses kept at proportionally variable temperatures. The best customers of these retail smokehouses are tourists and vacationists at the beach.

Dried and Hard-Salted Fish

The most important dry-salted fish produced in California is Alaska codfish. Every year hundreds of thousands of pounds of salted codfish are prepared in a factory at Belvedere on San Francisco Bay. The fishery commenced in 1863 and has continued without a break to the present. In 1935 about 512,000 fish, weighing 1,750,000 pounds dried weight, were landed at San Francisco by two schooners. The various codfish products find a market among both the foreign and American population of San Francisco and the western United States and in the West Indies, Central America and other tropical countries.

The cod are caught in Alaska waters by dory fishermen operating from schooners. The fish are cleaned, headed, split, and salted aboard the vessel. The salt draws out the moisture so that they are quite dry by the time they reach Belvedere. Upon arrival at the plant they are washed and placed in 100 per cent brine solution in which they are kept until needed. In preparation for market, the fish are dried thoroughly by sun or artificially, and then skinned, filleted, sliced, or compressed in a great variety of ways. The finished products are packed in tin or wooden boxes.

A number of species of fish are dry-salted at San Diego for the Portuguese market of San Francisco. Barracuda and yellowtail are the principal species. In years gone by, all the San Diego canneries dry-salted fish as a side line, but recently one or two plants have sufficed to meet the diminished demand. Production in 1933 and 1934 was higher than for the preceding two years. (See Fig. 3.)

The hard-salting method of preserving fish, as practiced at San Diego, is as follows: First the fish are cleaned, beheaded and split open.

Slits are cut in the flesh, more cuts for larger fish to permit penetration of salt, which is rubbed into the slits and sprinkled over the fish. A layer of salt is then sprinkled on the floor of the saltery and fish placed thereon. Then alternate layers of fish and salt are piled up. The fish are left that way until the moisture has ceased to run—a matter of 10 to 12 days usually. Then they are spread out on racks in the sun until quite dry. One day of sun-drying is sufficient in the summer, two during the winter. If the fish are too dry and hard they do not sell well, if too damp they do not keep well, so it is necessary to exert the utmost care in drying. The dried fish are packed in boxes and shipped to San Francisco.

Nearly every one of the fish markets on the municipal wharf at Monterey dries small amounts of fish for retail sale. The principal species are kingfish, rockfish, mackerel, and horse mackerel, of which the kingfish is probably the most important. Local Chinese, Japanese, Filipinos, and Italians are the largest consumers of the dried fish. The

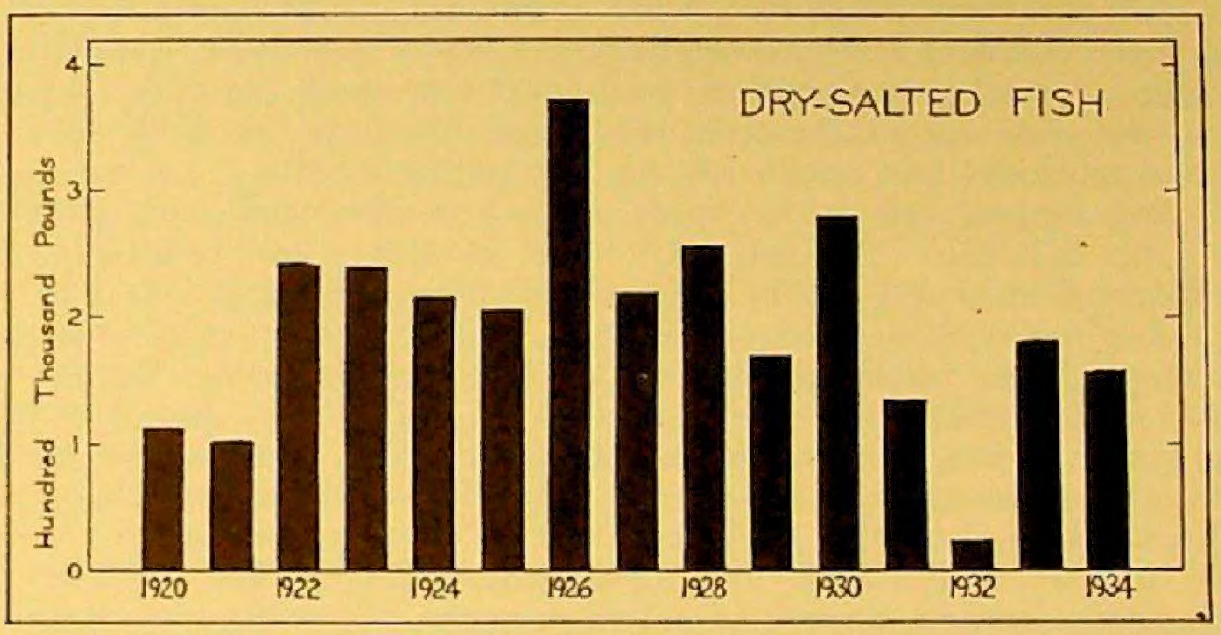

FIG. 3. Production of dried or hard-salted fish at San Diego, California, 1920–1934. As adequate statistics for dry-salting at other points are not available, only San Diego production is shown. Among the species included are: barracuda, yellowtail, black sea-bass, white sea-bass, bonito, mackerel, Spanish mackerel, sardine, mullet, tuna, rock bass, and rockfish.

process used is similar to the San Diego method. Mackerel and horse mackerel are split at the back, leaving the halves connected at the belly, but the kingfish and rockfish are split at the belly. The salted fish are put in shallow trays and placed on the market roofs for the sun-drying. The kingfish are tied in one-pound bunches with string run through holes in their tails. Several Chinese firms in San Francisco dry various kinds of fish on a wholesale scale. The most important species are sole and flounder, rockfish and kingfish. The production has been diminishing in recent years, each of the last few years to 1933 showing an output about 10,000 pounds below the preceding season. The 40,000-pound pack of 1933 and a production of 36,000 pounds in 1934 were the lowest on record. Most of the output is sold in the stores of Chinatown or exported to the Orient.

The Japanese fishermen living on Terminal Island and at San Diego dry a variety of fish for their own use. They place the fish in

screen trays which are hoisted to the tops of tall poles to expose the fish to the rays of the sun and to get them away from flies.

Chinese at Monterey sun-dry various kinds of fish for their own use, hanging the fish on low racks. Indians in northern California sun-dry large quantities of salmon, surf smelt and other fish for their winter food supply.

Salted and Pickled Fish

There are two general ways in which fish are brine-cured in California. One method, generally termed "salting," has been practiced in all parts of the world for centuries and is perhaps the simplest method of preserving fish. Mackerel, sardines, horse mackerel, herring, anchovies, and bonito are the most important species to be salted in this state. The other method is known as "pickling" or preserving in flavored brine. Sardines, herring, mackerel and anchovies are pickled in California.

A great deal of the salted fish produced in California is used for fish bait. Fish dealers throughout the state salt down quantities of sardines for sale to commercial and sport fishermen for bait. In addition, the fishermen themselves salt large amounts for their own use. Salted mackerel and anchovies are also popular baits.

Brine-cured fish to be used as food is prepared more carefully than the bait fish. The fish markets at Monterey salt relatively small amounts of mackerel and horse mackerel for retail sale. The wholesale fish dealers and one cannery at San Pedro brine-cure quantities of mackerel, horse mackerel and bonito from time to time. Occasionally small salting plants operate at San Diego, San Pedro, San Francisco, and other towns, but inadequate financing and unreceptive markets generally cause their early demise. At Marshalls on Tomales Bay, a saltery operated during 1934 and 1935. This plant produced considerable quantities of Scotch-cured herring and also smoked some herring. Among the largest buyers of salted fish are steamship operators who use the fish for the crews' mess and the passengers' table. At infrequent intervals, quantities of mackerel are salted and shipped to eastern United States. Improved methods of refrigeration and the expansion of the canned fish industry have cut heavily into the once flourishing salted fish business.

The fish to be used for salting are first cleaned and split or cut as desired. Mackerel are headed and sliced from end to end, either into two separate pieces or into halves joined at the belly. Bonito and other large fish are often halved and the "sides" cut into smaller pieces. Herring are usually salted whole after gilling and gutting. Small anchovies and sardines are salted whole without being cleaned. Large sardines are often either filleted or cut into segments. After being cut, the fish are washed in salt water, sprinkled with salt and then placed in a barrel with alternate layers of dry salt. When the barrel is full, a tight-fitting lid is placed over it. The salt draws out the natural moisture of the fish to form the brine. After about 10 days the fish are removed, given a light salting and repacked dry in the barrel. Fresh brine is then added to fill the container. Fish packed in this manner will keep indefinitely if the salter has done his work at all carefully and has used only first grade salt.

Since the repeal of the Eighteenth Amendment, the pickled fish business has been looking up to some extent. The various styles of fancy pickled sardines (often sold as herring) had been in competition with Norwegian products for a small market, but now favorable foreign exchange rates and the demands of beer parlors have combined to make it possible for several small concerns to operate. A fairly large plant at San Pedro has done a considerable business in pickled fish during the past two years (1934–1935).

Each producer has one or more recipes for preparing the "best pickled fish in the country". The sardines are pickled entire after cleaning, or as fillets, or in small pieces. A typical pickling fluid and method of use is as follows: The sardines are placed in salt brine containing sugar, vinegar, chopped onions, and pickling spice which consists of mustard, allspice, cloves, chili, and other ingredients. After eight days the "pickle" is drained off and a fresh batch of the same fluid is poured over the sardines. The fish keep indefinitely in the second solution.

Another type of salted fish is produced at Monterey, the "Honolulu sardine," which is neither brine-cured nor dry-salted in the exact meaning of either term. Large, entire sardines are packed vertically, heads up, in a wooden box, several handfuls of salt are sprinkled over them, and the box lid is nailed down. The boxes must be shipped and held in cold storage. As the name suggests this product is marketed in Honolulu.

In addition to the products mentioned above, several other kinds of salted and pickled fish, are, or have been, produced in California. The species salted include barracuda, black sea-bass, rock bass, sablefish, white sea-bass, rockfish, salmon, tuna, and yellowtail. Small amounts of salmon bellies are salted from time to time. Years ago octopus or "devil-fish" was salted for the Chinese trade.

Salacchini

The manufacture of salacchini, a salt and pressure-dried pack of sardines, was very important before the advent of prohibition. Many saloons served salacchini, as it is said to improve the flavor of light drinks at the same time tasting better itself when served with beverages. In 1918, the production was 2,000,000 pounds, but the industry declined markedly after the enactment of the Eighteenth Amendment. Since then one or two fairly good seasons have broken the downward trend of the pack, and at present production has diminished to practically nothing. With the return of legalized drinking the sardine canneries that make salacchini as a side line are hopeful of the future, although the expected boom has not yet materialized.

Monterey has always been the center of the salacchini industry. Until 1921, there was some produced at San Francisco, and until 1924 small amounts were made at San Pedro, but since then the entire output has been manufactured at Monterey.

The following is the method used in preparing salacchini: The sardines, preferably fat fall fish, are salted in barrels or tanks, their natural moisture providing the liquid. They are left in the brine 25 to 45 days, depending upon the weather and the size and fatness of the fish. After removing from the brine, they are subjected to a

pressure of 150 pounds per square inch, which forces out the natural oil and the brine and leaves the fish quite dry and very thin. They are then packed in cans or tin boxes of capacities varying from 10 to 100 pounds, the 22-pound can being most popular in recent years.

Dried Shrimp, Squid and Abalone

The shrimp fishery is one of the oldest fishery industries of California. Chinese commenced the capture and drying of shrimps on San Francisco Bay during the 1860s. At present there are several camps operated by Chinese and one by Americans. The dried shrimp is esteemed principally by Chinese, and nearly all of the output is exported to the Orient. Shrimp meal, which is used as poultry feed, fertilizer and fish food, is produced from the shells, heads and broken pieces sorted out after drying. In 1934, the production of dried shrimp meat on San Francisco Bay amounted to about 110,000 pounds. During that year 300,000 pounds of shrimp meal was manufactured. The 1934 production of these two commodities was a few thousand pounds above the average output for the past nine years (1926–1934).

As soon as the shrimps are landed at the camp they are cooked by boiling in salted water for fifteen minutes. Then they are screened to sort by size. The large ones are sold fresh, the small ones are dried. The Chinese spread the shrimps in a thin layer on outdoor platforms or floors where they are left to dry for several days, being turned occasionally. When dry, a roller is run over them to break the shells away from the meat. In a blower or fanning machine, the lighter heads and shells are separated from the meat. At the one American camp, the shrimps are kiln-dried and a rotary tumbler is used for separating out the shells. Sun-dried shrimps lose three-fifths of their weight in the process. The dried material yields about one-third meat and two-thirds meal by weight.

Squid have been dried at Monterey by Chinese since 1860. The dried squid is sold in the Chinatowns of San Francisco and other American cities to some extent, but the greater part of the production is exported to China. The runs of squid in Monterey Bay fluctuate greatly from year to year, and economic conditions in China are notoriously unstable, so the production of dried squid varies greatly. The best year on record was 1930 when 1,383,000 pounds were produced. There has been but one good season since then, conditions in China and business dissensions in Monterey preventing any production during the other years.

The squid are sun-dried in fields near Monterey. They are spread in an even thin layer on the ground, and left for three days to one week, depending on the weather, then raked into piles and placed in sacks. The squid are not cleaned, and dirt and grass are not sorted out during the baling. No salt is used at any time during the process. One ton of wet squid produces about 700 pounds of the dried product.

Previous to 1915, when protective legislation did away with the practice, Chinese and Japanese along the California coast dried quantities of abalone meat. Until stopped they were in a fair way to denuding our entire coast of these mollusks. Their camps were located at San Diego, the Channel Islands, Cayucos, Monterey, and other points. The sun-dried abalones were all shipped to China.

Tempra and Kamaboko

Two kinds of Japanese fish cakes are manufactured at San Pedro. These are known as tempra and kamaboko. They are produced by Japanese for the local Japanese trade.

Fresh barracuda is the principal constituent of both of these products. When barracuda are not available, other species of white-meat fish are utilized. As the first step in the preparation of either type of cake, the raw fish are skinned and filleted and all the black meat is removed. The white flesh is then put into a circular copper pot where it is broken up and stirred by rotating paddles. Salt and water are added from time to time. A Japanese powdered flavoring essence, called "aji-no-moto"; imparts a distinctive flavor to the product. The fish that is to be made into kamaboko is ground very fine, and when thoroughly mixed with the right amount of water is similar in appearance and texture to somewhat damp biscuit dough. It is shaped by hand into cakes about seven inches long and three inches wide, rounded on top to a height of about two inches. The cakes are formed, cooked and sold on bases made of thin pine boards. A "frosting" of coloring matter is often placed on top of the cake, strawberry red being the favorite color. The cakes are steam-cooked for half an hour, after which they are ready for market. They will keep one week in refrigeration. The tempra is not ground so fine as the kamaboko. A small amount of sliced carrot is added to the tempra mixture in addition to the same ingredients used for kamaboko. After thorough mixing, the tempra is formed into thin, rectangular cakes which are fried in deep oil. When cool, the cakes are ready for market. They remain good the same length of time as the kamaboko. Occasionally small quantities of both of these products are canned.

Conclusion

A number of specialty packs, in addition to those mentioned above, are put up from time to time as experiments or to fill small orders. Among these are Scotch-cured herrings, various kinds of anchovies, soused sardines in glass jars, and marinated sardines and sardine sirloins, also in glass containers.

The fish packers of California have built up what market they have solely on the merits of their products. That market could and should be larger. Smoked fish and other cured fisheries products are excellent foods—healthful, economical, delicious, and easily served. At present, marketing methods are antiquated and advertising is non-existent. With better prepared displays of attractively packaged and labelled products, supported by a vigorous advertising campaign, the cured fish business of California might well show an advance comparable to that of the canned fish industry.

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THE CALIFORNIA TRAWL FISHERY AND ITS CONSERVATION [1]

By G. H. Clark

Extent of Fishery

At the present time (1935) the California trawl fishery [2] is carried on in three-quarters of the coastal waters of the State. The San Francisco trawler fleet operates from Monterey on the south to the California-Oregon boundary and into Oregon waters. These waters are fished rather intensively from the three mile limit (roughly 25 to 30 fathoms) to the 100 fathom line. However, the seasons play a part in the amount of fishing in various regions. For instance, fishing is concentrated in the northern coastal regions from Fort Bragg to the Oregon boundary during the months from April-May to September-October, when the weather is more moderate than during winter months. Likewise, fishing is carried on during the late fall, winter and early spring off San Franciso, Monterey and Point Reyes, with occasional trips off Fort Bragg. This seasonal difference in fishing locality is due to the exploitation of the relatively virgin fishing grounds in the northern regions during the summer months. It is not to be construed from any evidence now available that the fish migrate from south to north in the summer months and vice versa in the winter months.

There is another fleet of boats operating the same type of gear out of Santa Barbara. It fishes the waters between Santa Barbara and San Luis Obispo, usually in shallow water between the coast and 35 fathoms. Seasonal fishing by locality or rather by depth is also apparent in this fishery as the boats fish in shallower water during the early spring, late January to April, where in this season of the year they obtain the best catches of the California halibut.

Complexity of Species

One fact of prime importance in relation to the conservation of the trawl fishery is the large number of commercially important species of fish taken by the drag nets and sold by the operator-dealers. A large number of species of various shapes and sizes is taken by the nets and marketed. Moreover, the size of individuals of a given species

[1] Contribution No. 152 from the California State Fisheries Laboratory, November, 1935.

[2] The California trawl fishery has been carried on since 1870 with the paranzella drag net, a net of Mediterranean origin, which is towed on the bottom of the sea behind and between two boats. With few exceptions this type of drag net has been used exclusively in California. However, some fishing was done from 1918 to 1924 in southern California with otter trawl drag nets, where one boat drags a net on the bottom and a large door or otter board is attached to each wing so that the force of the water while towing causes the boards to sheer out and spread the mouth of the net. In 1918 an unsuccessful attempt was made to operate an otter trawl off San Francisco; however in 1934–1935 two or three small boats in Monterey were able to operate this type of gear on a small scale during the spring and summer. On the other hand, one of the large paranzella operators in San Francisco had very little success with the gear even though using wire rope instead of manila line. (See Fig. 5.) (See Clark, 1935.)

varies greatly. Most of those taken are flatfish, which range in size from 7 inches to 4 feet in length; in addition, large numbers of round fish are taken, at times, such as rockfish, sablefish, cultus cod, tomcod, kingfish, hake, and shark. Even these vary in size and weight over a large range. Although the industry depends on four or five species for large production, *i.e.*, pointed-nosed sole, round-nosed sole, sand dab, rex sole, and flounder, the various other kinds of fish taken in the net, both flat and round fish, are an important part of the dealer's products, and consequently are valuable as long as they are taken in sufficient quantity to supply the existing market. Another item of importance is the operator's desire to catch and be able to offer for sale as large a variety of bottom fish as possible in order to keep all of his customers satisfied. As a result the boats endeavor to fish the various grounds so that variety is obtained over the course of a week's time. The drag net, scooping up the fish on and near the bottom does not discriminate as to species or sizes except such as escape through the mesh in the net. The fish caught in this type of net are nearly all dead when landed on deck so that those that are too small for the market or useless as food are wasted. When it becomes necessary to conserve by regulatory measures such species as are taken primarily by drag nets, the situation becomes complex because of the nature of the fishing apparatus and the large variety of fishes taken on the same grounds and at the same time. On the other hand if it were not for this type of fishing gear many of the fishes caught, principally soles, would not be taken in commercial quantities in California.

FIG. 4. Boat used in paranzella drag net fishing. Notice the fair lead for the manila warp on the stern. Photo by G. H. Clark, August 20, 1934.

Need of Conservation in the Trawl Fishery

From preliminary work on the catch per unit of effort of the principal species of flatfish taken by the San Francisco trawlers,[3] it was found that the catch per boat set per day had decreased in 11 years (1924–1934) for all species except one. Some had declined more than others, ranging in a percentage decrease from an 18 per cent to a 62 per cent for the entire area fished between Monterey and the California-Oregon line. The catch per boat day made off San Francisco had a greater decrease than the whole area, ranging from a 32 per cent to a 66 per cent percentage decrease according to species. However, the catch per boat day does not tell the whole story because new fishing grounds were developed over the period covered and especially since 1929, when the boats started fishing off Fort Bragg, Eureka, and north to the Oregon line. These new areas were almost virgin grounds; consequently, large catches were made the first few years. However, the catch per boat day decreased on these grounds, the percentage decline by species ranging from 31 per cent to 55 per cent from 1929 to 1934. Also the day as a measure of effort has not been comparable over the period, for as fish became scarce more drags were made each fishing day so that the number of drags per day has increased from 1 to 2, 3, 4, and sometimes to 5, at the present time. Consequently, were we able to measure the catch per drag, the decrease in catch or available fish on the grounds would have been greater than is shown by the

FIG. 5. Trying out otter boards on a paranzella net and boat. Note the board coming into the gallows. Photo by G. H. Clark, July 17, 1935.

[3] Bare mention is made of the trawl fishery out of Santa Barbara, principally because we have very little real knowledge of the fish taken or the operation of the gear. Paranzella nets are used to take bottom fish, approximately half of which consists of soles and half of California halibut. From unpublished observations there is very little waste of small fish in this fishery. (It is unlawful to possess more than 30 pounds of California halibut under four pounds in weight, consequently all small California halibut under this size taken by drag gear is wasted or is saved and used illegally.) More information is desired about the fishery of this region, and tests of mesh size to liberate the undersized halibut are planned.

catch per boat day. It is apparent in the boat catch figures that the catch has increased slightly in the San Francisco waters since 1931. This is possibly due to the concentration of fishing since 1929 in the northern State waters during the summer months, and so lessening the drain in the San Francisco region. However, at the same time the catch per boat day in the north has steadily decreased at a high rate since 1931, so that the effect on the entire trawl fishing grounds has been a general decline in catch per boat day.

FIG. 6. A sack of fish in a paranzella net at the surface alongside roller of the trawler. Photo by G. H. Clark, September 27, 1933.

There would seem to be little doubt that grounds fished by the San Francisco trawlers are becoming depleted of the more common flatfishes and that some method should be adopted to conserve and replenish the populations, and at the same time utilize the resource to as large an extent as is possible under good conservation principles.

Regulatory Methods

Regulatory methods to conserve fishery resources are fairly well standardized throughout the world. For instance, the most universally used correction for fish depletion is a closed season which is usually made to apply during the spawning season if it is known. Other practices of conservation are size limits, closed areas, regulation of types and sizes of gear used, and a more recent regulation of productivity by areas. Adequate and definite knowledge of the fish and fishery is a prerequisite for the application of conservation methods. However, it is sometimes necessary in an emergency to apply some method of conservation to a fishery in need of regulation without complete knowledge of the resource. It is true that in former years drastic conservation practices have been applied on very little information or erroneous conclusions, and many of these regulations still exist although conditions have changed and more has been learned about the fishery. On the other hand, many fisheries that were in need of protection were not regulated because of

lack of information, and consequently have decreased to an alarming extent. It is apparent that conservation agencies should so adjust regulatory measures as to meet changing conditions within the fishery. It is also desirable that thought be given to the type of regulation applied to a given fishery. In the event conservation is needed, care should be taken in the selection of the proposed conservation practice, even though complete knowledge of the resource is available, in order that it will have the most beneficial effect in building up the fishery and at the same time be least injurious to the industry, fishermen and dealers. Particularly is this true of conservation practices applied when only partial information of the fishery is available. Sudden and drastic regulation is apt to do more harm than good when applied to a fishery about which little is known; harm to the resource because it may be found later that the wrong method was used, and harm to the industry which may not have time to adjust itself to the sudden change.

Such a fishery should be regulated with extreme care, feeling the way, adopting at first those practices that seem to do most for the fishery and least harm to the industry; then, if necessary, in the light of increased knowledge of the fishery and the effect of the adopted regulations, changes can be made that are more efficient. It is desirable that flexibility of regulation be obtained if possible when a fishery is to be curbed. Sometimes this may be obtained by voluntary regulations within a well-knit industry applied over a period of years until complete knowledge of the fishery is obtained, otherwise laws once made may be difficult to amend or abolish if the need arises.

Regulation of the California Trawl Fishery

The California trawl fishery is one about which we have only partial knowledge. We have known for some time how much fish of each kind is delivered to the docks from this type of gear, and so we are able to determine the average catch per boat set per day over a period of years. This enables us to measure the success of the fishermen, which in turn gives us a measure of the populations of the various species taken by this gear from a rather large area. We now know (since January, 1934)[1] how many drags each boat makes each day, in what localized ocean area the drag is made, the length of the drag in time and miles, and the catch for the day's fishing. This information will become more valuable when available over a period of five to ten years. Thus we may be able to gauge the catch per drag time in localized regions, which will give us an extremely accurate measure of the abundance of bottom fish populations from year to year. We have already gained a great deal of information from the records kept by the boats on the distribution of the various species by months as shown by the catches made in different areas and depths. We have information on the proportions of species that make up the trade classifications, the size in these classifications, the percentage of small and waste fish in relation to large and marketable fish as brought up by these nets, and some knowledge is available of the size and age at

[1] In January, 1934, the Bureau of Commercial Fisheries, California Division of Fish and Game started a system of log books on the California trawl boats. These logs are uniform daily records of the fishing activities and catch of each trawler set.

maturity of the principal species. As yet we do not know, except superficially, the seasonal, geographic and depth distribution of the young of the principal species, the complete life history and growth rates, and the migrations, if any.

Closing certain areas is the only regulation that has been applied to this fishery in the past. It is now unlawful to fish within three miles of the shore with a drag net from Pigeon Point to the California-Oregon line and to operate this gear in less than 25 fathoms (150 feet) from Pigeon Point south to the mouth of the Carmel River. It is also illegal to fish with a drag in bays in District 18 (Carmel River to Ventura-Santa Barbara County line) or to have a drag net in possession in Districts 4, 19, 20, 20A and 21 (Ventura-Santa Barbara County line to the Mexican boundary).

FIG. 7. Unlacing sack of fish just brought aboard the drag boat. Photo by G. H. Clark, September 27, 1933.

The 3-mile and 25-fathom limit, which has been in effect for several years, was enacted originally because it was believed that the inshore waters were nursery grounds for small fish. This regulation was based on findings in the North Sea on the principal flatfish, the plaice. This restriction, although based on superficial knowledge of the distribution of small flatfish on the California coast, undoubtedly has been useful to the fishery, and at the same time has caused but little hardship to the industry because of the fact that there are extensive fishing grounds outside the 3-mile or 25-fathom limit. In the past year and a half the San Francisco trawler industry has voluntarily regulated itself through agreement on the size of mesh used in the trawl sack. This regulation although not mandatory or enforceable has been obeyed because the operators can see its advantage in the escapement alive of small, immature and unmarketable fish, thus allowing them to grow to mature and marketable size, and preventing waste while building up the population. Also, this regulation has very little effect on the amount of production as most of the escaped fish are unmarketable.

The San Francisco trawl fishery should not be subject to a sudden and drastic regulation by enactment of law until more complete knowledge of the fishery is available and particularly until the effect of the regulations, both legal and voluntary, are thoroughly tested. For instance, the economic effect of a closed season on fish taken by drag nets would be to cripple or bankrupt the companies which depend on this fishery for their business.

Savings Gear

The cause of the decline in the catch per boat day may be due to the waste of small, immature and unmarketable fish. As pointed out in a previous paper (Clark, 1935), the waste of small fish at sea, particularly the important pointed-nosed sole, is very great. Large numbers of small fish of this and other species have for years been caught in the drag nets of small mesh. These fish were landed on the deck of the vessel and all those too small for market use were dumped back dead into the sea. The pointed-nosed sole as well as most of the other species except sand dabs are not used for the market unless measuring 9 inches (229 mm.) total length or larger. Sand dabs are utilized as small as 6 inches (152 mm.) However, in years past the mesh in the drag nets did retain fish as small as 2 inches in length. The simplest solution of the waste problem would seem to be to enlarge the mesh in the nets to a size which would allow the fish under 6 or 9 inches to escape alive while the net is being towed, and so permit the fish to live and gain a marketable size. The problem is unfortunately more complex than it seems. What species are we to save? Are we to make the mesh large enough to allow small pointed-nosed sole and other small fish to escape, and lose all sand dabs with the smaller fish? Will the escapement free enough first-time spawners? What mesh size will permit maximum escapement of fish of agreed size? Where does the maximum escapement take place in a drag net—wings, throat or sack? These questions are vital and fortunately enough information is available to make a start in this problem.

In the first place, the San Francisco drag net fishery depends largely on two species of flatfish. The pointed-nosed sole accounts for 44 per cent of the yearly catch of these nets, the round-nosed sole for 21 per cent, the rex sole 6 per cent, halibut 2 per cent, sand dab 6 per cent, flounder 4 per cent, and turbot 1 per cent (from 1934 statistics). The other 16 per cent of the catch is made up of various other species, such as rockfish, sablefish, cultus cod, shark, skate, etc. It is apparent that we should conserve these species, the pointed- and round-nosed sole, that comprise most of the catch. Both of these species mature for the first time at the age of 3 years, when they measure 9 to 11 inches, so that a mesh that would allow 50 per cent of these fish to escape would be very beneficial in building up the populations of all the flatfishes even though for a time the sand dab catch was very small, containing only the larger individuals.

Considerable research has been done in Europe and on the Atlantic coast on the mesh size needed for the escapement of certain sized flat and round fish. Fulton (1894 and 1922), Holt (1895), Heincke (1908), Todd (1911), Johnstone (1910), Ridderstad (1915), Borley and Russell (1922), Wallace (1923), Pettersson (1925), Russell and

Edser (1926), Bowman (1928), Davis (1929 and 1934), Hefford (1929), Borowik (1930), and Herrington (1935) through experimental work with savings gear, mostly in trawl nets, have shown that: (1) The size of fish of each species retained and released is a function of the size of the mesh. (2) Seventy-five per cent of the fish is released while the net is being towed (contrary to the opinion of many fishermen who claim that the weight of the fish causes the meshes to close and no escapement takes place except when the net is being lifted) and so are saved for future capture at a larger size. (3) There appears to be a general tendency for the loss of small fish to be compensated by an increase in the number of marketable fish caught by larger mesh.

FIG. 8. A sack of fish taken by a small beam trawl with Division of Fish and Game boat "Albacore" in testing savings gear. Photo by H. B. Nudever, August 16, 1934.

As a result of preliminary work done in 1934 with a small beam trawl in testing mesh size, it was recommended to the San Francisco trawl industry that they enlarge the meshes in the sack from 3½-inch to 5-inch stretched mesh in order to allow some escapement of small fish. It was voluntarily agreed by the industry to adopt the change in July, 1934, so that since that time as old sacks were worn out they were replaced by new bags having 5-inch mesh in the extreme end and in half the bottom of the sack. Reported and observed results of this enlargement of sack meshes indicate that less small fish are retained than formerly, also less trash and mud are caught in the sack, and faster speed is possible because of less resistance.

In a continuation of the experimental work of testing mesh size in relation to fish escapement, a trip was made in the summer of 1935 on the Division of Fish and Game boat "Albacore." A small otter board net was used, with a foot rope of 40 feet, wings of 6-inch mesh, square, belly and belly top of 5-inch mesh. The plan was to test various mesh sizes on the same grounds at the same time with a "trouser trawl," one leg of the sack being one mesh size and the other leg another mesh size. After 9 hauls with this split sack over various

grounds it became apparent that the leg with the small mesh did the bulk of the fishing, for both small and large flatfish. Due to the fishing action or to the resistance of the water while being towed, the smaller mesh sack opened wider at the mouth and at the same time pulled the mouth of the larger mesh sack closed, so that in such a small net (8 feet wide at sack attachment or 4 feet for split sacks) the small mesh sack received almost all the fish taken into the net. As a result of this differential in fishing, a full sack was attached to the net and alternate hauls made with different sized sacks. (See Fig. 10.) From the results obtained it was evident, even before the measurements of fish were summarized, that the 3½-inch-mesh sack was not retaining any small fish to speak of, and from the plotted material there was a rather sharp cut-off of fish sizes at 9 to 10 inches (230–250 mm.) except for one species, sand dab. (Sand dabs are unusually wide for

FIG. 9. Shooting small otter board trawl over stern of Division of Fish and Game boat "Albacore." Notice winch in foreground and wire leading to sheer legs in the stern. Photo by G. H. Clark, September 3, 1935.

their length so would tend to be retained at shorter lengths than other flatfish.) Selectiveness between the 5- and 3½-inch sacks, from the material taken, did not give much evidence that the larger mesh let greater numbers of small fish escape except in the catch of sand dabs, some in the catch of rex sole and of slippery sole. However, the small amount of work done with the 6-inch mesh indicated that only the larger fish were taken (those above 12.5 inches long). Commercial paranzella trawls, using 3½-inch mesh in the sack, catch and retain a great number of 2- to 9-inch fish so it was surprising that the 3½-inch mesh sack on the small otter trawl did not do the same, unless of course most of the small fish escaped before reaching the sack.

In order to prove or disprove that small fish were escaping to a large extent through the fore part of the net, the wings and throat, tests were made on four different grounds, each test the same day, using two or three different sized nets and sacks in alternate hauls.

The procedure was as follows: One drag was made with a 40-foot ground rope otter trawl made up entirely of 1½-inch stretched mesh, wings, throat and sack. This net took everything on the bottom except the very smallest animal. Next, another drag was made back over the same ground with a 40-foot ground rope trawl of the same design as the small mesh net, made of 6-inch wings, 5-inch throat and 1½-inch sack. It was thought that this net should make the same catch as the first net used except for those fish that escape in the fore part of the net. A third drag was made back over the same ground[5] with a net of 6-inch wings, 5-inch throat and 5- or 6-inch sack. This net should take only large fish, for those small fish that did not escape in the fore-part of the net should be liberated from the sack.

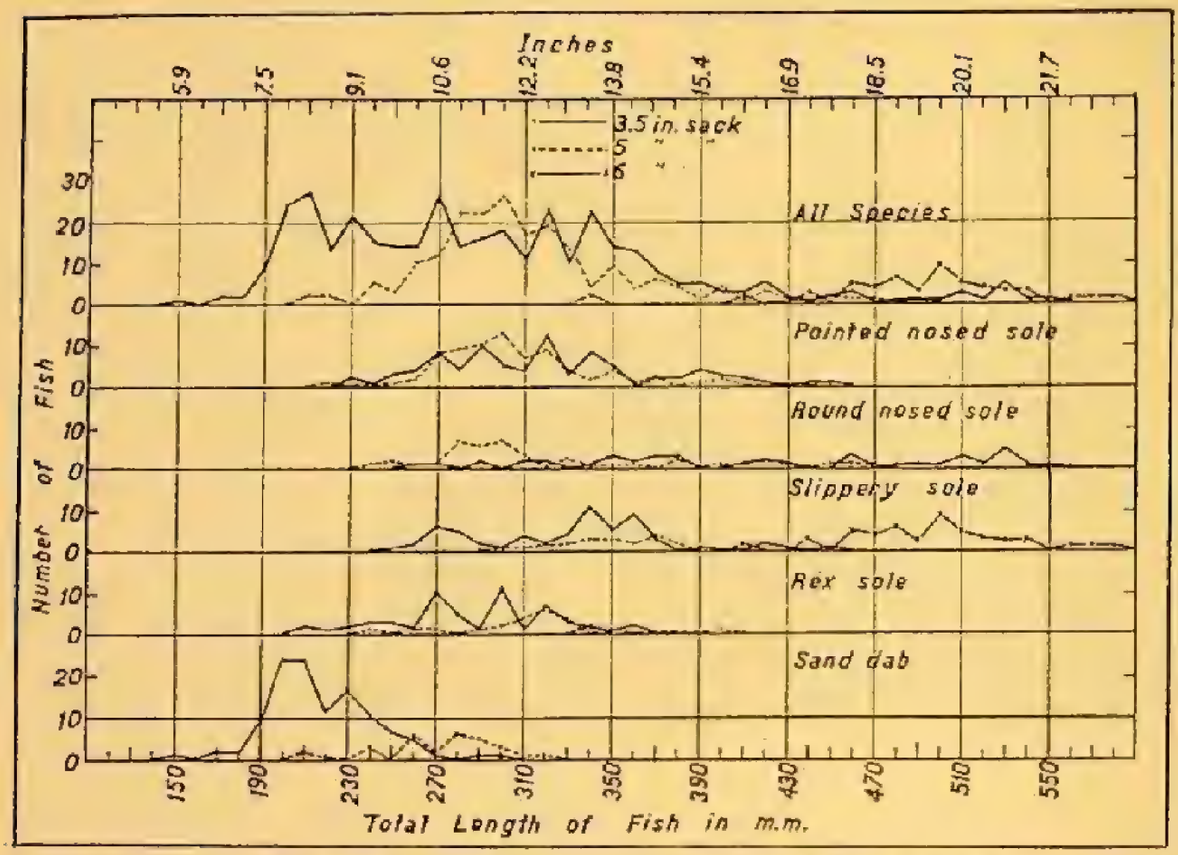

FIG. 10. Numbers of fish by sizes taken in 3½-, 5- and 6-inch mesh sacks. 359 fish taken by 3½-inch mesh, 195 by 5-inch mesh, and 52 by 6-inch mesh.

The results of these tests are shown in Figure 11 (A, B, C, D). For simplicity all flatfish from each drag were grouped together at length intervals of 10 mm. and then plotted to show the amounts of fish taken at each size by each type of gear. In the first test (A of Fig. 11) the net of 1½-inch mesh throughout and the net of 6-inch wings, 5-inch throat and 1½-inch sack took approximately the same sizes of fish; but the former net took 3014 more fish, almost all small or below 250 mm. (9.8 inches). The net of 6-inch wings, 5-inch throat and 5-inch sack took very few fish and none less than 250 mm. (9.8 inches). In the second test on a different ground (B of Fig 11) the same occurred as in the first test except fewer fish were taken.

[5] It is realized of course that the drag was not made over the exact spot that the previous drag covered but in the same general locality, same depth and same type of bottom. All drags were comparable in time.

Again in the third test the results as shown by C of Fig. 11 are similar except in this test the large net with a large sack was not used. The last test (D of Fig. 11) demonstrates the same general effect as the previous trials.

The data from these three tests clearly indicate for the gear used and grounds fished that a large majority of the small fish, under 9 to 10 inches, must have escaped in the fore part of the trawl, wings and throat. Calculating from the numbers of fish taken and retained by each net used in the experimental hauls, it is shown that the 1½-inch-mesh net caught from 87 to 97 per cent more fish and the majority of them small. The percentage for the individual tests are 94, 91, 87, and 97, respectively.

The results of escapement in the fore part of the net are much higher than other workers have obtained. Todd (1911) found that the greatest escapement through the fore part of the net for flatfish was ½ per cent in the forward top piece and 1 or 2 per cent in the top throat, so that the sack accounted for most of the escapement. Borowik (1930), who also tested escapement in the various parts of the trawl by covering the large mesh net with small mesh, reported that for flounder and dabs 20 per cent of the escapement occurred in the bottom parts of the net and 50 per cent on the sides. In other experiments he concluded that the front part of the net and the sack were of equal importance in the escapement of small fish. Inasmuch as the data were not obtained from alternate or parallel hauls and as the nets were of somewhat different design there is some doubt as to the significance of Borowik's results.

The high percentage of escapement from the front part of the nets as shown in Figure 11 may be due in part to their design,[6] but certainly not entirely. Whether or not the same escapement would occur with a commercial size otter trawl or with a paranzella net is not known; it has not been tried.

Results of Savings Mesh on Commercial Trawls

As stated above, the San Francisco trawlers voluntarily agreed in July of 1934 to enlarge the meshes in the extreme end and bottom of the paranzella trawl sacks. By December, 1934, almost all trawls in use in the San Francisco fleet had been converted to the larger mesh. As a consequence, the catches made during the months from January and including July, 1935, were made with the enlarged mesh in the sacks. Although actual changes in landed fish are not striking as yet, changes in the catch at sea and in the action of the nets are apparent. When the 3½-inch mesh in the sacks was used, large numbers of fish too small for market use were dumped over the side of the vessel. Whereas, with the enlarged mesh (5-inch) in the sack only, there is a considerable decrease in small, waste fish taken in the net. In addition, the sorting work has been reduced because of the lack of small fish; the larger mesh allows rocks, trash, and mud to filter through the meshes, preventing damage to the net or snagging

[6] The nets used were small otter trawls, 40-foot ground rope, 26-foot head rope, 50 feet from end of wing to end of sack hung in the usual manner. The boards, 2x4 feet, weighing 170 pounds each, were operated on the V. D. principle, set at 5 fathoms from the wings. The net was towed with a ¾-inch wire line to each board, with an approximate 3 to 1 ratio of wire to depth.

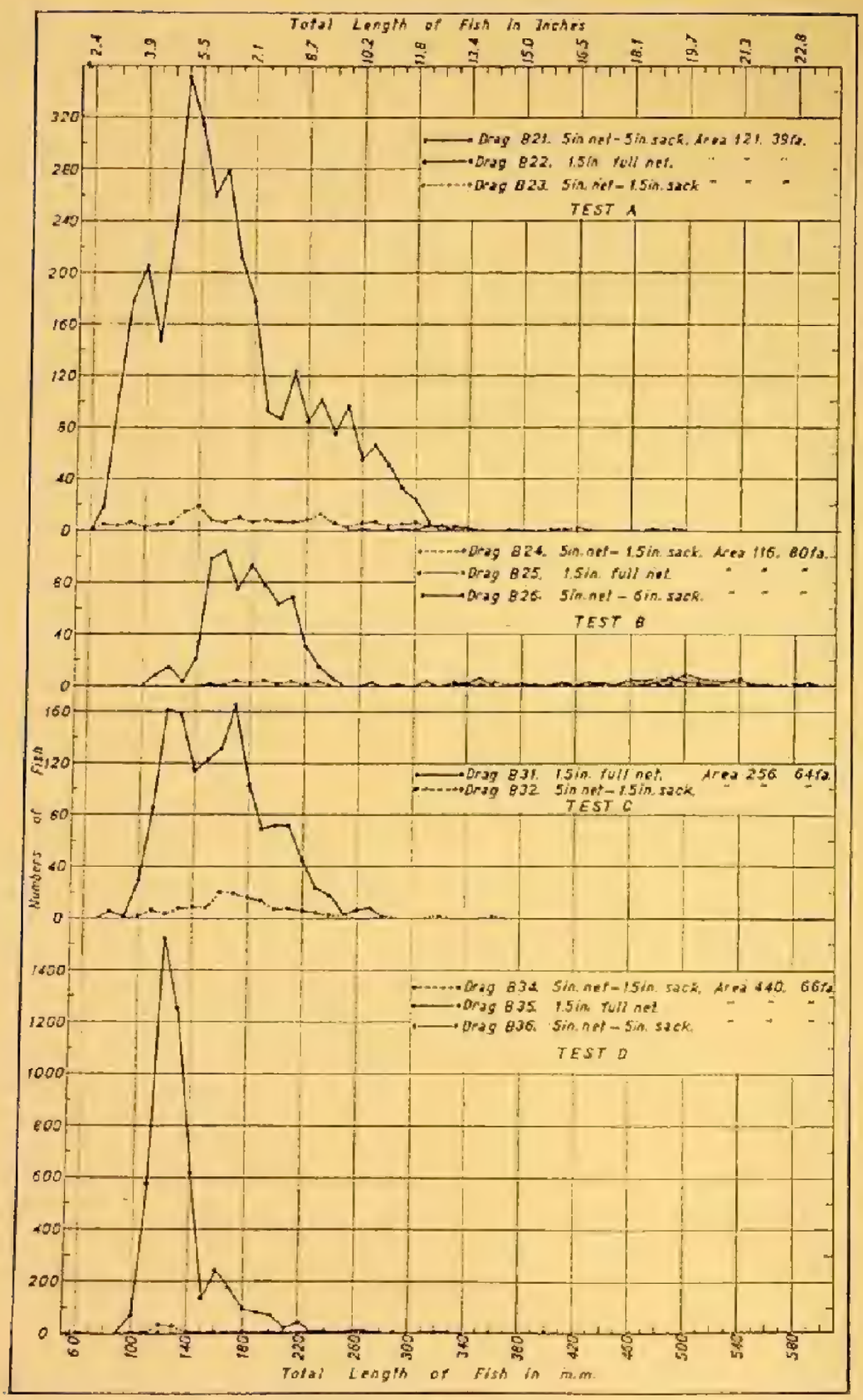

FIG. 11. Numbers of flatfishes by sizes taken by nets of different mesh size on the same grounds on the same day:

Drag B21	18 fish	Drag B25	735 fish	Drag B34	122 fish
Drag B22	3405 fish	Drag B26	57 fish	Drag B35	4458 fish
Drag B23	191 fish	Drag B31	1107 fish	Drag B36	12 fish
Drag B24	63 fish	Drag B32	145 fish		

in the mud; the free flow of water allows faster movement of the net at the same engine speed, increasing catching efficiency; and the cost of webbing and mending is reduced. Even in the landed catch the changes can be noted in the sizes of what are termed small soles. There are actually more fish and more poundage in this classification but the majority of the fish are not small soles in the old meaning but medium sized, the standard of the small sole having been raised.

Conservation of the Trawl Fishery

The ideal conservation of a fishery resource is the utmost utilization without endangering the future supply. Conservation of a marine fishery is a balance between the fish taken from the population by man or other means and the fish added to the population by the natural reproductive process. What that balance is must be determined for each fishery by a knowledge of the fish and fishery and by experimentation. Regulation then becomes an experiment in an attempt to create this balance; consequently, constant observation of the effects of such regulation is of the utmost importance.

Conservation of the San Francisco trawl fishery with full utilization of this food resource will be achieved if we are able over a series of years to find and maintain this balance through experimentation of mesh regulation, either voluntary or enforced.

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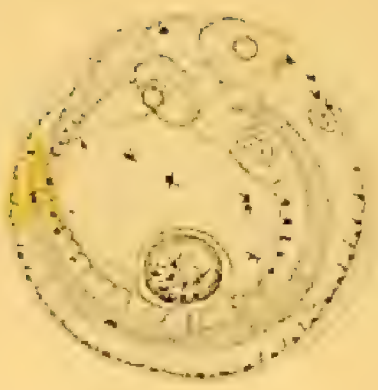
A

B

C



D

E

F

G

1mm.

FIG. 12. Eggs and Larvae of Pacific Mackerel.

The four stages of egg development were drawn from two eggs, taken in a tow net in Santa Monica Bay, California. The larvae were hatched from tow-netted eggs. The ocean temperature at the time and place of capture was 65½° F.; the eggs were kept as close to this temperature as could be managed without the use of constant temperature equipment. The temperature ranged from 62° to 70° F. but was at these extremes only a small proportion of the time. The larvae were less closely controlled in this respect.

A: 12 hours after capture.

B: 17 hours after capture. Black pigment began to appear about 1½ hours after this stage.

C: 30 hours after capture. There are scattered black spots on the dorsal side in addition to the lateral ones shown.

D: 44 hours after capture, and 2 hours before hatching.

E: Newly hatched larva. Ventral view. Since young larvae always float "belly up" this is the view most easily obtained.

F: Larva at about 8 hours.

G: Larva at about 2½ days. Larvae keep this general arrangement of black pigment until they are at least 10 days old.

A DESCRIPTION OF THE EGGS AND LARVAE OF THE PACIFIC MACKEREL

(*Pneumatophorus diego*)[1]

By DONALD H. FRY, JR.

Many hundreds of species of marine fish inhabit the waters of the Pacific Coast of North America, but the eggs and larvae of only a very few are known. To identify the previously unknown eggs of any species is often quite a task and very little of this work has been done. The most satisfactory and frequently the easiest way to make such an identification is by stripping and artificial fertilization. In some cases it proves difficult or impossible to obtain fully ripe fish and becomes necessary to examine nearly mature ovarian eggs which have been placed in sea water, and (assuming the eggs are pelagic) to make tow net hauls and search the catches for eggs which closely correspond to the ovarian ones previously examined. The results obtained by this method are always open to doubt unless the eggs and larvae can be compared with those of very closely related species, or unless the larvae can be kept alive until they have assumed enough adult characters to make identification certain. In the case of the Pacific mackerel it was found necessary to use tow net material instead of artificially fertilized eggs. In this case the newly hatched larvae so closely resembled those of the Japanese and Atlantic mackerels that there was no possible doubt of their identity, and in addition one larva was kept alive for three weeks. At the end of that time it was unmistakable.

Mackerel eggs in the earlier stages of their development are very hard to recognize unless the investigator is very familiar with them. By the time the embryos are well developed and the yellow pigment has formed, the eggs can be easily identified from a description. Newly hatched larvae are unmistakable. All the above refers to living material; preserved specimens are more difficult to identify. All the preserving media which we have tried distort young eggs somewhat and we are unable to recognize them. Advanced eggs lose all traces of yellow pigment and although recognizable when preserved are much harder to identify than when alive. Newly hatched larvae can be easily recognized even when preserved.

During the latter part of the spawning season (June and July) the fertilized eggs average about 1.05 to 1.08 mm. in diameter and range from about 0.9 to 1.2 mm. Judging from measurements of mature ovarian eggs, there seems to be a possibility that early in the season (May) fertilized mackerel eggs may average as large as 1.2 mm. in diameter with some individuals reaching 1.35 mm. There is a single oil globule which is about 0.26 mm. in diameter. The paravitelline space is very narrow—about 0.02 mm.—and unless the microscope is

[1] Contribution No. 151 from the California State Fisheries Laboratory, November, 1935.

focused on the right place the egg appears to have no paravitelline space at all. The size of egg, size of oil globule, and especially the very narrow paravitelline space form the best means of identifying eggs in which no pigment has formed.

After the embryo is segmented, black pigment, the eye lenses and yellow pigment appear in the order named. Figure 12-C shows a mackerel egg about 4 hours after the first appearance of yellow pigment (65° to 66° F.) The embryo lies along almost three-fourths of the circumference of the egg. The pattern of black pigment on the body and on the oil globule does not change radically until several hours after hatching. The oil globule is pigmented with melanophores which are always irregular in shape and are never spaced with geometrical uniformity over the entire surface. Usually they are definitely clumped in a large patch which is most often on the anterior portion of the oil globule. On the sides of the body the melanophores average about one pair for each body segment and are spaced with fair regularity. In addition there are scattered spots on the anterior portion of the back and on top of the head (these are not shown in the drawing). Yellow pigment is present at the posterior edge of the eyeballs and in a closely grouped cluster of chromatophores which form a band around the tail.

Figure 12-D shows an egg which is almost ready to hatch. The embryo is bent into a little more than a full circle and is quite crowded. The distribution of the black pigment has not changed radically since the stage described in the last paragraph. The yellow pigment is as previously described except that in addition there is yellow around the oil globule. The yellow band around the tail shows more clearly in this drawing due to the difference in position of the embryo.

Newly hatched larvae are about 3 mm. long. The yolk sac is a little over twice as long as wide and when viewed from above or below (Fig. 12-E) it appears rather bluntly rounded on the ends, thus giving the larva an unusual but not unique shape. The vent is immediately behind the yolk sac. There are about 34 muscle bands. The shape, position of vent, and general appearance are shared with other scombroid larvae. There are some which are about the same size. The number of myomeres and the yellow tail band make identification positive. Eight hours after hatching (65° to 66° F.) the larva has changed little in appearance except for a noticeable reduction in the size of the yolk sac (Fig. 12-F).

After this stage the black pigment along the back begins to disappear. At 18 or 20 hours there is often a stage where the larva is almost devoid of black pigment. By 30 hours a row of black spots has formed along the ventral side of the tail on each side of the fin fold and there is black pigment along the top of the body cavity. This pattern is retained until the larva is at least 10 days old and probably longer. The yellow tail band dwindles in size: by 2½ days it is a small patch, and by 4 days or less it has entirely disappeared.

The number of myomeres, which was about 34 at the time of hatching is gradually reduced in number. At 4 days there are 31, the number the fish retains through life.

A PRELIMINARY SUMMARY OF THE LIFE HISTORY OF THE PACIFIC MACKEREL

(*Pneumatophorus diego*)[1]

By DONALD H. FRY, JR.

Introduction

Previous to the year 1928, the Pacific mackerel (*Pneumatophorus diego*) was just one more food fish of moderate importance. Practically all the catch of about three million pounds per year was taken by hook and line fishermen at San Pedro, San Diego and Monterey. This was consumed fresh except for minor amounts which were smoked, salted, or used for occasional experimental canning. By means of such experimental work, a satisfactory method of packing mackerel was developed and late in 1927, one cannery started to work in earnest. There was no trouble selling the new product and as a result most of the fish canners in southern California rushed into the new business in 1928. Net boats went to work for the canneries since they could supply the fish more cheaply and in much larger quantities. In the course of a few months, what had been a steady fishery, taking about three million pounds per year, became an erratic industry which from 1928 to 1935 has averaged over fifty million pounds annually.

When a species becomes this important it is advisable to watch it closely for signs of overfishing and to learn as much as possible about its habits and life history in order that suitable protective measures can be applied if these should prove necessary. This is being done by the California Division of Fish and Game. The work is still in progress and the findings are subject to constant revision.

Pneumatophorus diego is a true mackerel; like all members of its family, it is a pelagic schooling fish with erratic migratory habits. Among the forms most closely related to it are the chub mackerel (*P. grex*) of the Atlantic coast and the Japanese species (*P. japonicus*). The Atlantic mackerel (*Scomber scomber*) is less closely related. All of these species belong to the family Scombridae.

Distribution

The range of the Pacific mackerel is at least from southern Alaska to the tip of Lower California. Apparently it is not found along the mainland coast of Mexico nor in the Gulf of California. It may seem strange that a species should occur along the west coast of Lower California but not in the Gulf at the same latitude. The reason is that the waters of the Gulf, though in the temperate zone, are equatorial in temperature.

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[1] Contribution No. 147 from the California State Fisheries Laboratory, November, 1935.

Abundance Throughout Range

Due to its movements and erratic habits the mackerel is not continually abundant at any one spot. One month the schools may be congregated in a small area, the next month they may be twenty to fifty miles away or the whole region may be alive with them. Even during the height of the fishing season they may disappear almost entirely for a week or so. During part of the year they are always scarce. All this must be taken into account when discussing the abundance of this species in any region.

In southern California mackerel are exceedingly abundant. Amounts ranging up to a hundred million pounds per year have been taken from the fishing grounds which lie between Pt. Conception and San Diego.

In the vicinity of Monterey, the fish are sometimes very abundant. There is a steady hook and line fishery at that port, and there are more than enough fish to supply the fresh fish markets' demand of roughly one million pounds per year. On the other hand the canneries have had spasmodic and on the whole rather poor success when they have attempted to get much larger quantities of mackerel for canning purposes. This would seem to indicate that mackerel are constantly present only in relatively small numbers, but we can not be sure of this. The net fishermen who work for the canneries at Monterey are not experienced in taking mackerel, and seldom go ten miles from port to look for these fish. In southern California, by way of contrast, the mackerel net fishermen are far more expert and often go as much as 75 or 80 miles from port when necessary. If the Monterey fishermen improve their skill and extend their range, some of these apparent fluctuations in abundance may disappear.

North of Monterey there is no mackerel fishery but sardine fishermen operating out of San Francisco, Oregon and British Columbia sometimes take mackerel in quantity. Usually these fish are mixed with a much larger amount of sardines but occasionally a fisherman makes a mistake and sets for a school which turns out to contain nothing but mackerel.

Along the coast of Lower California at least as far south as Cape San Lazaro (540 nautical miles from San Diego) mackerel are exceedingly abundant at times. Near Ensenada there is a cannery which packs mackerel. Ensenada is so close to the international boundary line that it can be regarded as part of the southern California region in a biological though not in a political sense. South of Ensenada all our information has been obtained during research trips made by California's fishery patrol and research boat, M. V. *Bluefin*. From these observations we know that mackerel are very abundant at least part of the time. Many more trips will have to be made before we can be sure whether or not they are abundant at all times.

Relative Abundance Throughout Year

In all places where mackerel are steadily fished, we know that they are not equally abundant at all times of the year. There are definite periods of abundance and scarcity which occur every season

at about the same time. To show these changes, the landings made each month of certain seasons in the San Pedro and Monterey regions are plotted in Fig. 13.

The catches shown for the San Pedro district satisfactorily demonstrate the actual changes in abundance. It will be noticed that there is a low period from January through April. This is due to a marked scarcity of fish which may start as early as mid-December or (more rarely) as late as March. When it does commence, the net boats are

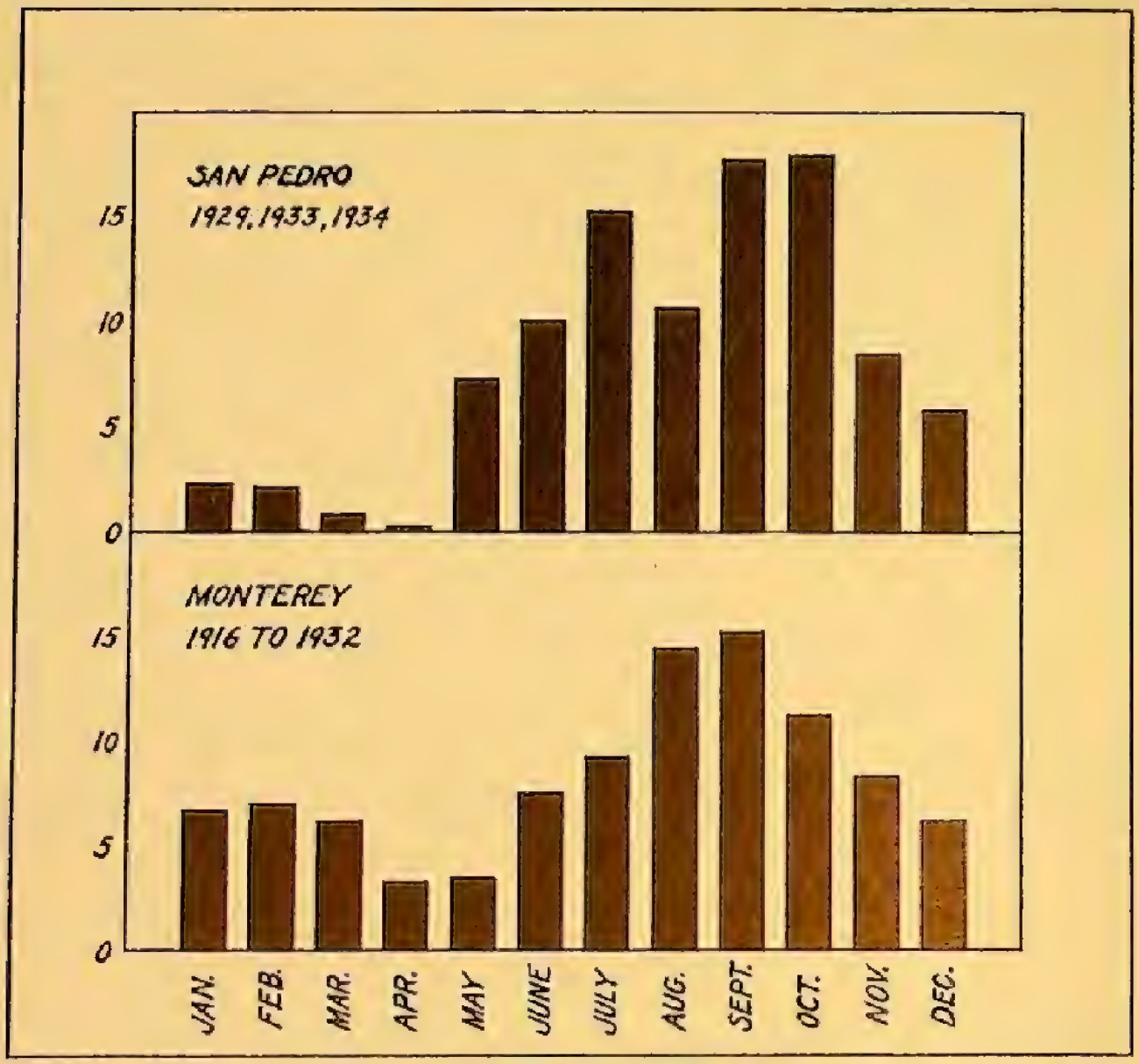

FIG. 13. Mackerel seasons in the San Pedro and Monterey districts. This figure shows the percentage of the year's catch which is landed each month. At San Pedro the relative changes in abundance would probably not differ markedly from the above graph. At Monterey mackerel are much more abundant during the summer and fall than the figure would indicate; the catch is held down by a limited demand.

usually unable to find any fish at all. Hook and line boats do take mackerel during this period, but never in any great quantity. The period of scarcity ends in May and then fishing starts with a rush. Fishing is usually excellent throughout the summer and fall, although there may be a midseason slump any time from June to September. This temporary decline is most apt to occur in August. The abrupt drop in November is partly due to the opening of the sardine canning season on November first. From then on the demand for mackerel is

not so great. This makes it difficult to determine just when the fish do begin to become scarcer, but does not mask the beginning of the real period of scarcity which is so severe that the canneries are forced to suspend mackerel canning entirely.

To show the relative abundance at San Pedro the years 1929, 1933 and 1934 were chosen because the canners were anxious to pack mackerel throughout all of each of those years. Except at the opening of the sardine season, there were no sudden changes in demand, the result of which could be mistaken for changes in abundance.

At Monterey there is a period of scarcity comparable to the one at Los Angeles Harbor but ending a month later. The difference between the catches during the periods of abundance and of scarcity is comparatively slight at Monterey. This is due to the limited demand. When fish are abundant, the markets state in advance how much they will buy from each fisherman and thus hold the catch down to amounts that can be marketed.

The monthly trend for Monterey was made by averaging the years from 1916 to 1932. Since 1932 there have been sporadic canning ventures, and as a result the demand has been so erratic that these later years could not be averaged with the earlier ones.

Spawning

Mackerel which are under 11½ inches total length at the beginning of a spawning season will not spawn that season; some of the 12 and 12½-inch fish and over three-fourths of the 13-inch fish will spawn. In terms of age—the yearling fish do not spawn whereas most of the two-year-olds do. The above holds true for California waters. Some mackerel from the southern part of Lower California seem to mature at a smaller size.

Most mackerel spawn two or more times each season. Some young fish which have just matured spawn only once.

Spawning Season

In southern California spawning begins in late April or early May. The heaviest spawning is from the middle of May to early July, and the season virtually ends in August, although a few ripe females have been taken in September. For some reason a few, very few, ripe males may be found during any month of the year.

In Lower California we know that there is heavy spawning in June and early July, but we do not know the limits of the season.

From Pt. Conception northward we have no proof that the mackerel spawn at all.

Spawning Areas

Mackerel spawn in the open ocean and the eggs float freely at or near the surface. They hatch in about three days, the hatching time varying with the temperature. To determine the spawning areas, conical nets of silk bolting cloth are towed through the water and the catches searched for mackerel eggs. This method gives definite positive evidence of spawning, but if no eggs are found, all that can be assumed is that no fish have spawned in that vicinity within the

FIG. 14. Mackerel spawning grounds and fishing areas. More research will undoubtedly prove some or all of the spawning grounds to be larger than here indicated. The larvae found at Cape San Lucas were about 2 weeks old and may have drifted there from some distance away.

last three days or so, since any eggs spawned before that time would have hatched.

All eggs so far taken have been in water less than 100 fathoms (600 feet) deep, between 57° and 72° F., surface temperature, and over a level or gently sloping bottom. Most of the eggs are spawned in water under 40 fathoms deep and between 62° and 69° F. Eggs may be taken at times in water less than 2 fathoms deep—just outside the breakers.

Mackerel eggs have been taken from Santa Monica Bay (34° N.) to Pequeña Bay (26° N.). In addition to the eggs, larvae about 2 weeks old were taken at Cape San Lucas (22° 50′ N.).

South of this range, and in the Gulf of California, mackerel are not known to exist. To the north of this known spawning range, mackerel are present, sometimes in great numbers.

North of Pt. Conception (34° 30′ N.), the surface waters near shore are nearly always colder than 57°, the minimum temperature at which mackerel eggs have been found.

There is additional evidence to indicate that mackerel do not spawn in the vicinity of Monterey (36° 40′ N.). As the spawning season approaches, maturing fish are taken but none which will spawn within several weeks. Later in the season spent fish are taken but to date we have seen no ripe or nearly ripe individuals. Apparently the fish leave the Monterey district to spawn, at which time they may either migrate south or they move off shore into warmer waters of the California current. An off-shore migration would be decidedly different from the habits observed farther south where most if not all of the spawning is close to shore.

As shown on the map, spawning along the mainland shore is divided into four major areas which can be designated as: southern California, Cape Colnett, Cerros Island, and Pequeña Bay. In addition to the above, larvae were found at Cape San Lucas. These may have drifted some distance but it seems probable that they were spawned much closer to the Cape than Pequeña Bay.

The gaps between these areas are doubtless due in part to our not yet having covered the ground often enough, but in addition there are two regions, one on each side of Cerros Island where the inshore waters during the spawning season are too cold for spawning. As far as physical conditions are concerned there seems to be no reason why spawning should not be practically continuous from southern California to the Cape Colnett area and possibly from Pequeña Bay to Cape San Lucas as well. The Cerros Island spawning area may prove to be much larger than indicated on the map, but on the basis of present evidence it does not appear at all likely that it will ever be connected with areas to the north or south.

Nursery Grounds

Numbers of mackerel, a few months old, have been seen and taken by us from Cape San Lucas to Monterey. It is possible they may be found farther north. According to the residents at Cape San Lucas, this season (1935) was the first time in about eight years that young mackerel had been there. How far south they ordinarily range we can not say. These young fish are scattered up and down the

coast without any apparent consistency. All those we have taken have been close to shore, but they have been taken off open sandy beaches, in the kelp, in open bays, in inclosed bays, in rocky coves, off the islands and mainland, and even in water so polluted that it was hard to believe anything could exist there. The distribution is quite uneven. One area will have them in abundance—another very similar area will have few or none.

Growth Rate

Mackerel, like many marine fish, grow very rapidly during the first few months of their existence. At the end of a year they average a little over 11 inches (snout to tip of tail); by the end of the second year they are a little over 13 inches; and four-year-old fish average about 15 inches. The largest fish taken in any numbers average about 17½ inches. We are not prepared to say how old these fish are. The

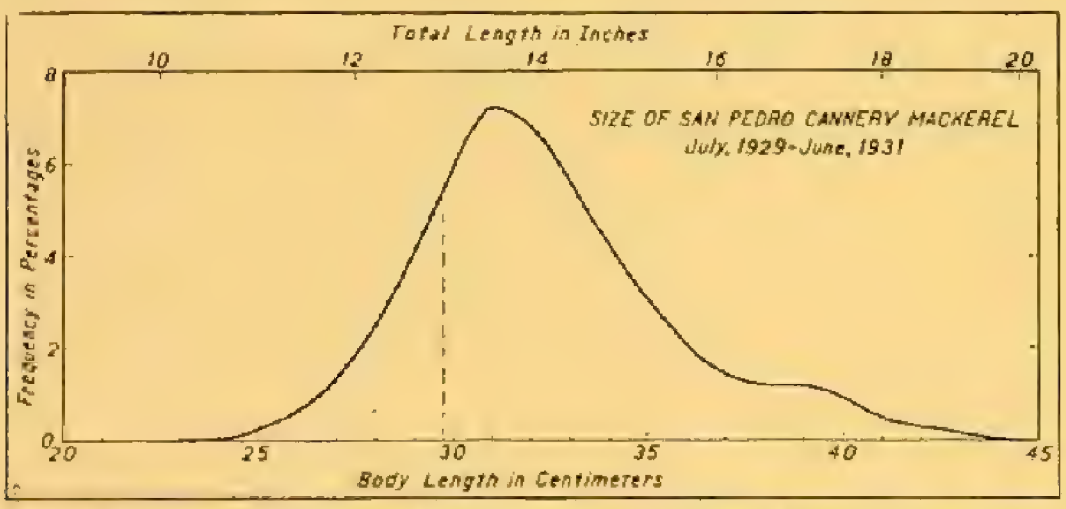

FIG. 15. Size of all mackerel sampled at San Pedro canneries, July, 1929, to June, 1931, inclusive. Number of fish at each half-centimeter expressed as a percentage of total number—21,400 fish of both sexes. Vertical line at 13 inches, total length, the minimum size limit sometimes set by canneries.

largest individuals range up to 20 inches, and one unusual specimen measured 22¼ inches, but this was one fish in many million.

With the older fish of any species it is increasingly difficult to determine the age, no matter what method is used. This is particularly true of the mackerel. We can not say how long these fish live but it is known that a great many reach an age of five years; this age-group at times forms the bulk of the catch. Seven-year-olds are common and it seems probable that an appreciable percentage live 9 or 10 years.

The difference in growth rate of individuals is enough so that a large two-year-old will be larger than a small fish of twice its age.

Weight of Mackerel at Various Lengths

Mackerel increase in weight much more rapidly than in length. If a fish retains the same shape its weight would increase as the cube of its length; for example, if it is doubled in length its weight would be multiplied by eight. Mackerel do not grow in this way; they increase in width more rapidly then they do in length, and as a result the weight increases as the 3.4 power of the length. A mackerel which

doubles its length multiplies its weight by $10\frac{1}{2}$. A few approximate weights and lengths are given here. These figures represent a rough average. Individuals can always be found which will diverge widely from these averages, and even the average weight-length relationship of the entire population is not constant.

Weight	Length in inches
1 oz.	$6\frac{1}{2}$
2 oz.	$7\frac{3}{4}$
4 oz.	$9\frac{1}{2}$
8 oz.	$11\frac{3}{4}$
1 lb.	$14\frac{1}{2}$
$1\frac{1}{2}$ lb.	$16\frac{1}{4}$
2 lb.	$17\frac{3}{4}$
$2\frac{1}{2}$ lb.	$18\frac{3}{4}$

Commercial Sizes

The distribution of sizes taken in the commercial catch at San Pedro is shown in Fig. 15. This represents 21,400 fish taken by nets and by hook and line. The bulk of the catch is made up of two-, three- and four-year-old fish. At various times, different ages predominate. There may be a few weeks when four- or even five-year-old fish will form the bulk of the catch, then these may move out and be replaced by a population which is almost all two-year-olds. At other times the fish are mixed and no one age predominates. The size variation from month to month is shown in Fig. 16. This is an average of five seasons and consequently shows the usual changes—not the extreme ones. These variations, while of great interest biologically, are of little interest to the industry. There is, however, one happening which occurs periodically and is a great annoyance to the industry. As a general rule there is an influx of 12-inch fish (a little over a year old) in August. This is shown in Fig. 17. These fish are smaller than the industry wants. Usually they do not appear in large enough numbers to inconvenience the packers but occasionally there is a very large incoming group. When this happens there are disputes between the canners, who do not want the fish, and the fishermen, who are unable to avoid them. The argument continues until the small fish settle it by moving out of the fishing area. This great abundance of small fish, although an annoyance at the time, is of course ultimately very valuable to the industry. The spawning success of mackerel, like that of most fishes, is subject to great fluctuation. There may be one or two years of successful spawning and then several very poor seasons. These periodic "bumper crops" of small fish are vital in building and maintaining the population.

Food

The mackerel is equipped with a tremendous appetite and very little discretion in its use. Any animal matter, alive or dead, will do very nicely as food and if there is enough of it to enable the mackerel to gorge himself to the bursting point, so much the better. The usual diet includes anything he can swallow, from fish and squid several inches long down to copepods (small free swimming crustaceans

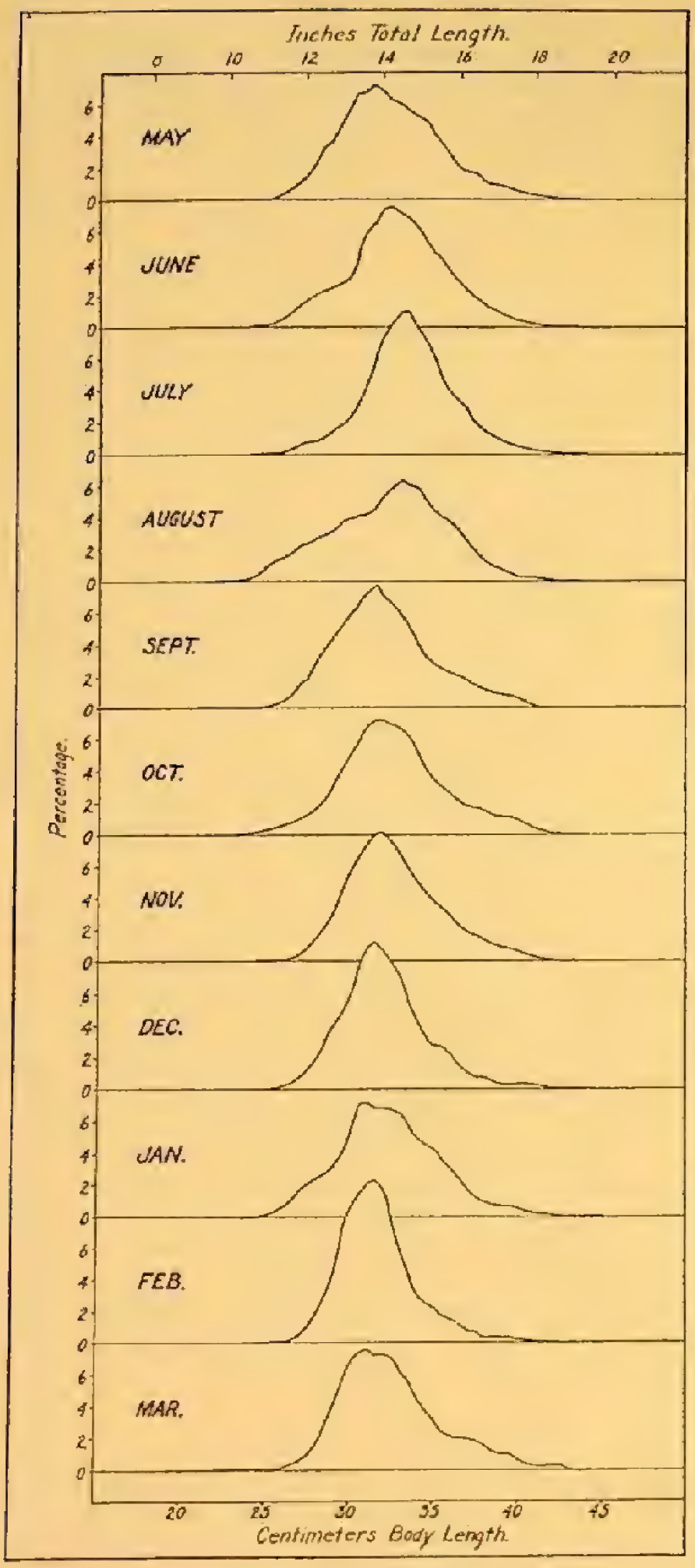

FIG. 16. Sizes of mackerel in the San Pedro cannery catch by months. An average of 5 seasons, 1929–1934.

about the size and general shape of a flea). Copepods and somewhat larger crustaceans, such as schizopods, form a large proportion of the mackerel's food, probably because of their great abundance. In general mackerel feed on one kind of food at a time, for example, copepods, anchovies or squid, but not a mixture of these.

Although as a rule mackerel are exceedingly voracious, there are times when they appear decidedly "choosy" about their food or even ignore all offerings entirely. They are most apt to be in this mood in the spring or early summer.

Migration

The most important question relating to the migration of mackerel is brought about by the tremendous tonnages taken in southern California waters. Are the fishermen making their catches from a local population which stays, for example, between Point Conception and Ensenada, or from a general population which inhabits a much larger range and different groups of which are continually passing through southern California waters? If there are extensive movements, how far do they extend, and are they

made by an appreciable percentage of the population, or only by stragglers? Is there enough movement so that if the southern California population is heavily overfished, enough mackerel will move in from other regions to replenish the population in a year or two, or is there so much movement that if the southern California area shows serious signs of overfishing it means that the population of the entire Pacific coast has been badly depleted?

We hope to get data which will enable us to answer these questions by tagging large numbers of mackerel at points all along the California

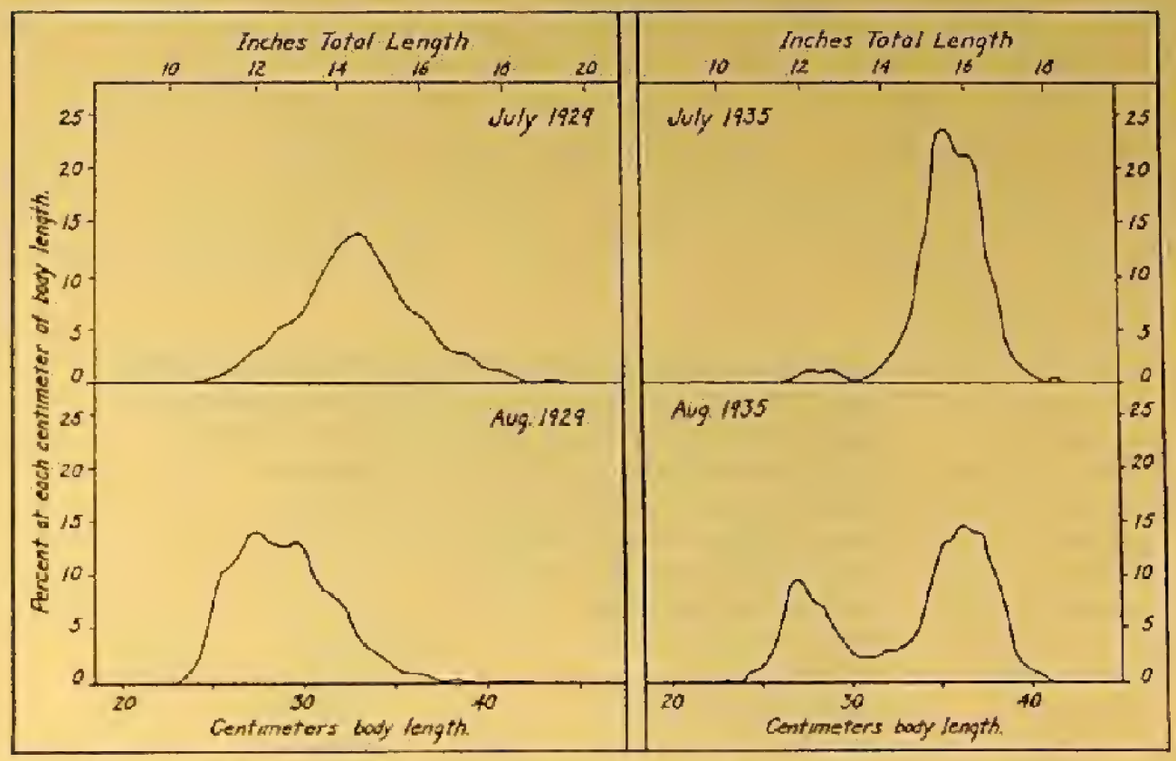

FIG. 17. Appearance of "bumper crops" of young mackerel in the cannery catch. This figure compares the length frequencies of the cannery catches of July and August of 1929 and 1935 and shows the tremendous influx of small fish in August of those years. For an average influx see July and August in Figure 16.

and Lower California coasts, and noting from how far and in what numbers the tagged fish appear in the southern California catches.

The tag used is a small strap of metal which is clamped on to the gill cover with a special pair of pliers. The fish are caught, tagged, measured and released as quickly as possible. The work has only just begun—950 fish have been tagged, but they have been out only a short while and no recoveries have been made to date. A reward of fifty cents is being offered for the return of each tag and seventy-five cents if the fish is returned with the tag in place.

WHAT IS THE WORLD'S GREATEST FISHING PORT? [1]

By Richard S. Croker

A question frequently discussed in fisheries circles is, "what city can justly lay claim to being the world's foremost fishing center?" The present paper attempts to settle the question.

At the outset it may be said that two factors can be used as a basis for comparison: volume of catch and monetary value of catch. We need not be concerned with the number of fishermen or number of boats; it is the catch that is important. The leading port as far as tonnage goes need not be the town with the most highly valued fishery.

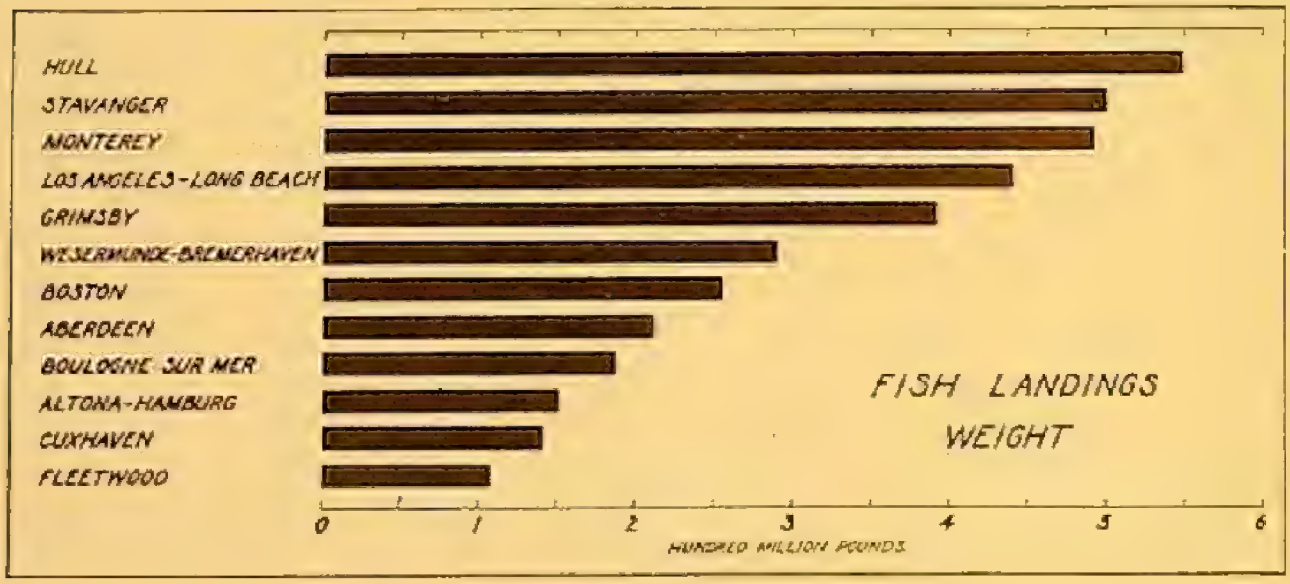

Fig. 18.

For the sake of brevity it was found necessary to omit ports with large volume and negligible value and those with small but valuable fisheries. Of the many studied, the twelve selected ports best balance these two factors. Owing to the difficulty of obtaining detailed statistics from some countries the study is really incomplete. Because of varying methods of collecting statistics and of evaluating the catch at the several ports, the figures are not completely comparable. However, they are the best that can be had.

The city of Hull in England receives the heaviest landings of any fishing port in the world, with the possible exception of some city for which statistics are not available. Hull's 550,000,000 pound catch is closely followed by the 500,000,000 pounds credited to the Norwegian sardine port of Stavanger. If the 1934 figures for Stavanger were

[1] Contribution No. 153 from the California State Fisheries Laboratory. October, 1935.

available, both the poundage and value of that port would probably be greater than the 1932 totals used, as the fishing industry nearly everywhere improved over that two-year period. Two California ports are close behind; Monterey with 490,000,000 pounds and Los Angeles-Long Beach with 50,000,000 less. (See Fig. 18.) San Francisco Bay, California, would rank among the leaders with a catch of 156,000,000 pounds, but as most of that tonnage consists of low-priced sardines, the value of her fisheries is much too low to warrant inclusion in the comparison.

Grimsby, England, although fifth in volume ranks first in value with landings in 1934 worth $21,000,000. (See Fig. 19.) Hull's catch, valued at $17,000,000, is not far behind. Monterey, with a catch consisting almost wholly of sardines, is the twelfth in value although a good third in volume. Enough tuna and other high-priced fish is landed at Los Angeles-Long Beach, in addition to sardines, to bring the total valuation of that port's landings to above twice the amount received by Monterey fishermen for their labors. California's leading

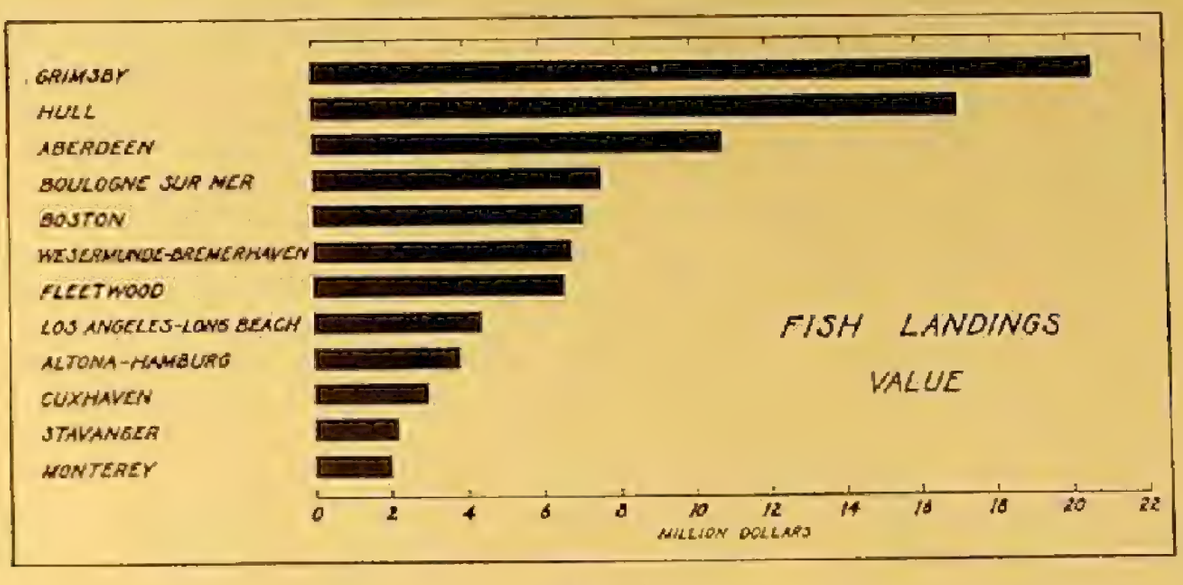

FIG. 19.

tuna port, San Diego, with a tonnage too low to rank in the comparison, accounts for a value of $2,900,000, which is more than the sardine ports of Stavanger and Monterey can boast. (See Table 1.)

Still we ask, "what is the world's greatest fishing port?" Is it Hull with its enormous poundage, or is it Grimsby with its greater monetary return? Perhaps a glance at the map of England will answer our question. There, we find that Grimsby and Hull are situated on opposite banks of the River Humber, just 15 miles apart. In the broadest sense they can be considered as one port—although their citizens would never admit it. As such, their combined catch of 940,000,000 pounds, valued at $38,000,000, would certainly put the Humber ports in undisputed possession of first place among the fishing centers of the world.

TABLE 1

LEADING FISHING PORTS OF THE WORLD*

Name and Location	*Pounds*	*Value U. S. Dollars*	*Year*
Hull, England	549,000,000	17,100,000	1934
Grimsby, England	391,000,000	20,700,000	1934
Aberdeen, Scotland	212,600,000	10,800,000	1934
Wesermunde and Bremerhaven, Germany	289,800,000	6,800,000	1933
Boston, Massachusetts	255,100,000	7,100,000	1934
Los Angeles and Long Beach, California	440,000,000	4,400,000	1934
Boulogne-sur-Mer, France	187,700,000	7,600,000	1933
Stavanger, Norway	199,800,000	2,200,000	1932
Monterey, California	492,100,000	2,000,000	1934
Fleetwood, England	108,000,000	6,600,000	1934
Altona and Hamburg, Germany	151,200,000	3,800,000	1933
Cuxhaven, Germany	141,600,000	3,000,000	1933

* Figures compiled from various governmental publications for most recent dates available.

THE REPLACEMENT OF TEETH IN DEER AS A MEANS OF AGE DETERMINATION

By DONALD D. MCLEAN

The replacement of teeth in deer is a means of definitely determining their age when the animal is less than three years old. The dental formula for adult deer of the genus Odocoileus is as follows: Incisors 0/4; canines 0/0; premolars 3/3 and molars 3/3. This formula is, of course, just half of the two jaws, and would therefore make a total of 32 teeth for the complete dentition. Since the deer is a ruminant it has no upper front incisors.

They are born with 8 temporary incisors and 12 premolars fully grown and 4 molars just appearing through the gums as in Fig. 20 A. The undeveloped second and third molars are shown deeply imbedded in the jaw.

Figure 20 B shows the developing process still going on; the first molar has been completely grown and the second and third have developed more than in Fig. 20 A.

In Figure 3 the replacement of the temporary incisors is shown. This begins from the middle and extends laterally. This takes place when the animal is about one year old.

Figure 20 D shows the third or last molar just appearing and the three premolars being replaced by the permanent premolars, bringing the animal toward maturity. The mature jaw is shown in Fig. 20 E. This final change takes place during the latter part of the second year.

After the animal is three years old it becomes more difficult to make any definite determination of its age. As the animal becomes older the teeth become worn and flattened and the cusps are ground off. At the more advanced ages of around seven or eight years or sometimes more the incisors are often lost and in extreme cases they are entirely lost before the animal dies of old age.

FIG. 20 A

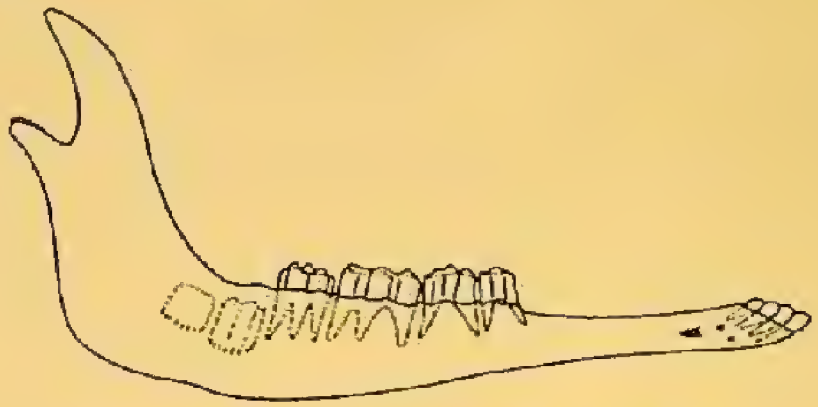

FIG. 20 B

1

2.

3.

4.

FIG 20 C

FIG 20 D

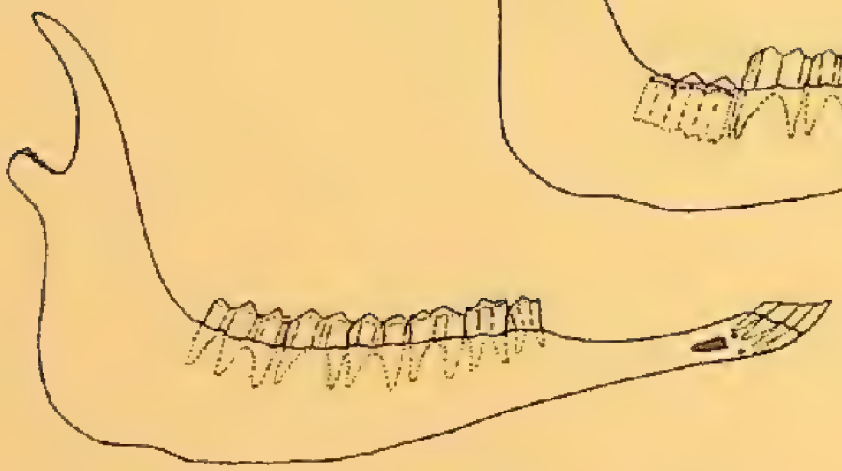

FIG 20 E

Fig. 20. Teeth of deer at various stages of growth. (A) At birth. (B) At five or six months. (C) Replacement of temporary incisors when the animal is ten or twelve months old. (D) In second year. (E) At three or more years.

CALIFORNIA FISH AND GAME

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Vol. 22 JANUARY, 1936 No. 1

A. T. JERGINS, NEW FISH AND GAME COMMISSIONER

With the resignation of Commissioner C. E. Houchin, of Bakersfield, due to press of personal business, Governor Frank Merriam appointed A. T. Jergins, of Los Angeles, as a member of the Fish and Game Commission.

Mr. Jergins is well known as a sportsman and conservationist. For many years, he has been a very close friend and business associate of former Commissioner Ralph H. Clock.

He has a splendid working knowledge of the Division of Fish and Game and will be a decided help to us. We are fortunate that Governor Merriam has given us such a splendid commissioner.—*Herbert C. Davis.*

IN MEMORIAM, W. H. SHEBLEY

Mr. William H. Shebley, at his retirement in May, 1933, from the service of the California Fish and Game Commission, had devoted precisely fifty years of his life to the study of fish culture in his native state. He died at Sacramento on November 7, 1935.

He began his career in May, 1883, under the guidance of his father, J. V. Shebley, in a small hatchery located in Nevada County. Shebley, Sr. was the first fish culturist in California, having previously been a noted game fish authority in Illinois.

From this small beginning, by close observation and study, supplemented by the books of the most prominent fish culturists in the United States and abroad, together with an active correspondence with the authors, exchanging views on some of the more intricate prob-

W. H. SHEBLEY

lems, he ultimately became a recognized leader in his chosen field.

He had acquired by personal observation an intimate knowledge of our streams and lakes as well as other waters wherein game fish might thrive and he successfully introduced the Loch Leven, Eastern Brook and other varieties of trout as well as maintained the runs of Quinnat salmon in the rivers of the state.

From the small Nevada County hatchery, he was promoted to the superintendency of the Sisson—now Mt. Shasta Hatchery. He served for 21 years as head of the Bureau of Fish Culture and lived to see the original small hatchery expand into a great system of 28 plants throughout the state. It was indeed a great record of accomplishment and stands without a parallel in our country. It justified the fact that he had served under sixteen governors and scores of fish and game commissioners, holding over from one administration to another while strictly adhering to his policies and amply justifying them.

Mr. Shebley leaves a wife and seven grown children to mourn his loss besides thousands of friends throughout the state to which this pioneer in fish culture had contributed so much.—*Charles A. Vogelsang.*

IN MEMORIAM, K. J. RANSDELL

K. J. RANSDELL

We regret to report the sudden passing of Warden K. J. Ransdell, who served in the Bureau of Patrol and Law Enforcement since 1924. Although Mr. Ransdell had been in poor health for the past few years, he continued his work up to the time of his death. He is survived by a wife and one child, to whom we wish to express our sincere sympathies.

TWO NEW PATROL BOATS LAUNCHED

The Division of Fish and Game on November 17, 1935, at Wilmington, California, launched two new boats to be used in patrol work.

Dr. E. C. Moore, president of the Fish and Game Commission, was in charge of the launchings and christenings. Miss Katherine DeMille christened the *Broadbill* and Miss Rosalind Keith christened the *Quinnat III.*

The *Broadbill* is to be used for the patrol of the Orange County coast line, Santa Catalina Island and other sections of the southern coast. Heretofore, this patrol work has been done by the *Bluefin* which is considered too large and slow for this kind of work. The *Bluefin* will remain in service but a large part of its duties will consist of ocean fish research work. The *Broadbill* is stationed at Newport Harbor.

The *Quinnat III* is stationed at Yacht Harbor, in San Francisco, where it has been used in patrolling the sardine fishing areas.

Dr. Moore emphasizes the fact that the addition of these new boats to our force is only a forerunner to the enforcement of the law which requires all sportsmen who fish for game fish in the ocean to take out a license which costs $2.00. A campaign of education along these lines, supported by sportsmen and the officials of south coast cities was started so that the local residents would be aware that they must buy this license.

These boats were purchased from Fellows and Stewart at a total cost of $6,160 each. They are of the water taxi type equipped with single 275 h.p. Hall Scott Invader motors with speed of 21 miles per hour. Each boat is 45 feet long.

Among those who participated in the exercises marking the launchings were: Dr. E. C. Moore, Herbert C. Davis, E. L. Macaulay, C. S. Bauder and members of the southern patrol district.

FIG 21. Two new patrol boats. At left, *Broadbill;* at right, *Quinnat III*

NEW METHODS FOR COMMERCIAL FISHERIES STATISTICS

For those who may be skeptical about the usefulness and the possibilities of developing a system of statistics in relation to a conservation program involving wild life, we would recommend for reading material the latest commercial fisheries "catch bulletin,"* recently issued from the California State Fisheries Laboratory. The dry-as-dust statistics of the commercial fish catch of California have been given a touch of romance in this, the fourth of a series of publications which deal with detailed records of the catch. The object of the bulletin, aside from presenting the tables for the five years, 1930–1934, inclusive, was to outline the history of the statistical system: the collection of the great masses of material, the speedy handling and condensing into accurate summaries which form the backbone of the biological and administrative work.

The group of authors is composed of staff members who have followed the development of the statistical system from its inception, each one has fitted a facet into the development of the work. W. L. Scofield outlines the "Achievements through flexibility" and gives the ultimate aim of the statistical system. Geraldine Conner gives the history of its development in "Modernizing commercial fisheries statistics." H. B. Nidever has written on the "Commercial fishing boat numbering system," and tells of the neeessity of a permanent boat number for each fishing craft. G. H. Clark in "Logs on California trawlers" shows the way for the next step in advance, introduction of logs on all of the fishing boats. Finally, H. C. Godsil's "Locality records and the tuna fishery" carries the advancing statistical work to a broader field, where the landings in California ports include fishes brought from distant foreign banks. The statistical tables were compiled from records gathered under the State's statistical system, every member of the staff of the Bureau of Commercial Fisheries and of the laboratory cooperating in this program.—*G. C., November 25, 1935.*

BIG-EYED BASS TAKEN AT MONTEREY

On October 28, 1935, a big-eyed bass, *Xenistius californiensis*, was taken with a catch of kingfish, *Genyonemus lineatus*, in the southern portion of Monterey Bay between Monterey and Moss Landing. This is about 200 miles north of its normal range, which is from southern California southward along the Lower California coast and into the Gulf of California. The specimen, nine inches in length, was called to our attention by I. Takigawa, owner of the Pacific Mutual Fish Company.

The big-eyed bass has at times been confused with the striped bass to which it bears a superficial resemblance. It belongs, however, to a different family, Lutianidae, and can be readily distinguished from the striped bass because the stripes are orange-brown instead of

* The commercial fish catch of California for the years 1930–1934, inclusive, by the staff of the Bureau of Commercial Fisheries. Calif. Div. Fish and Game, Fish Bull. no. 44, 124 pp., 1935.

blackish and the eye is much larger in proportion to the head. The big-eyed bass is described by E. C. Starks in CALIFORNIA FISH AND GAME, vol. 5, p. 66, and by Lionel A. Walford in vol. 18, pp. 262–263.—*J. B. Phillips, California State Fisheries Laboratory, November 4, 1935.*

NOTES ON THE OCEAN SUNFISH, *Mola mola*.

On several occasions during the fall of 1935 specimens of the sunfish, *Mola mola*, have been seen in the catch of the sardine boats

FIG. 22. The ocean sunfish, *Mola mola*. Photo by D. H. Fry, Jr.

in the San Francisco region. Most of the fish are small, ranging from 1½ to 3 feet in length, but on September 9, 1935, a large specimen was brought to the F. E. Booth plant at Pittsburg. The writer was not present, but the *Mola* was estimated at 6 feet in length and 1 ton in weight. Unfortunately no one present made any measurements, so the exact size can not be stated.

In keeping with the bizarre external appearance of these creatures, they present several anatomical features of unusual interest. The skin is greatly thickened, even in small specimens being over a half an inch thick on some parts of the body. This appears to be a thickening of the subcutaneous connective tissue which is very dense, almost hyaline. The intestine is long in proportion to body length as compared with many fishes, and there is present an enormous gall bladder with a correspondingly large bile duct. The skeleton is cartilaginous and may be easily sliced with a knife, in this respect being similar to that of the sharks and rays.

Examination of the stomachs of three specimens revealed no evidence of food, but the habits of the sunfish indicate that it is a plankton feeder, living on minute organisms that float near the surface. This will await verification by microscopic examination of the stomach and intestinal contents. In all specimens examined there was a heavy infestation of the digestive tract by tapeworms. The right lobe of the liver of one specimen harbored a number of worms which have as yet not been identified.

It has been reported that these fish, as they float on their sides near the surface of the water, are sometimes attacked by sea gulls that fly down and peck at them, and that the fish make no apparent effort to escape. It may be that a goodly supply of sensory nerves is unnecessary in the presence of such a thick skin, so making the creature impervious to the raucous attacks of its pursuers, a truly noble adaptation.—*Richard B. Tibby, California State Fisheries Laboratory, October, 1935.*

A JACK SMELT (*Atherinopsis californiensis* Girard) WITH A RUBBER BAND ENCIRCLING ITS BODY

Within the last forty years a rather large number of fishes, their bodies encircled by rubber bands, has been reported from the shores of the Atlantic, but so far as I know, no similar record has been published for the Pacific. It is, therefore, perhaps worthy of note that such a fish has been captured in Monterey Bay, California. This specimen, a jack smelt (*Atherinopsis californiensis* Girard), 245 mm. in standard length, was taken off Santa Cruz about September 20, 1932, and was presented to the Hopkins Marine Station by Mr. A. D'Acquisto of the Del Monte Fishing and Packing Company.

A rubber band encircled the body of the fish slightly anterior to the base of the ventral fins as may be seen in the Figure. Dorsally and laterally it had cut a groove 8 mm. in maximum width and 2 mm. in maximum depth, which remained as an open wound devoid of skin or scales except for a short space on the right side where the integument had been regenerated, due evidently to the loss of elasticity of the rubber band and its consequent bulging out from the body wall in this

region. Ventrally, the band cutting into the soft abdominal wall had sunk so deeply that the tissues had regenerated over it and the fish, apparently healthy in every other respect, had been swimming around with an unjointed rubber band encircling its body. It may be noted that on the right side of the body, and, therefore, not shown in the Figure, the rubber band served as the base for the attachment of a hydroid colony about 30 mm. in length.

This phenomenon of banded fish, striking as it may be, does not appear to be of particularly rare occurrence. D'Acquisto on making inquiry among the fishermen was informed that a similar fish was taken at Santa Cruz in 1931 and one or two the year before, and there is a rumor of several such fishes appearing in the commercial catch some thirty years ago. Gudger (1928) reported on a number of mackerel (*Scomber scombrus*) similarly encumbered, being taken on the New England coast. In many of these cases the band had become embedded and covered by regenerated skin, and in one case the band

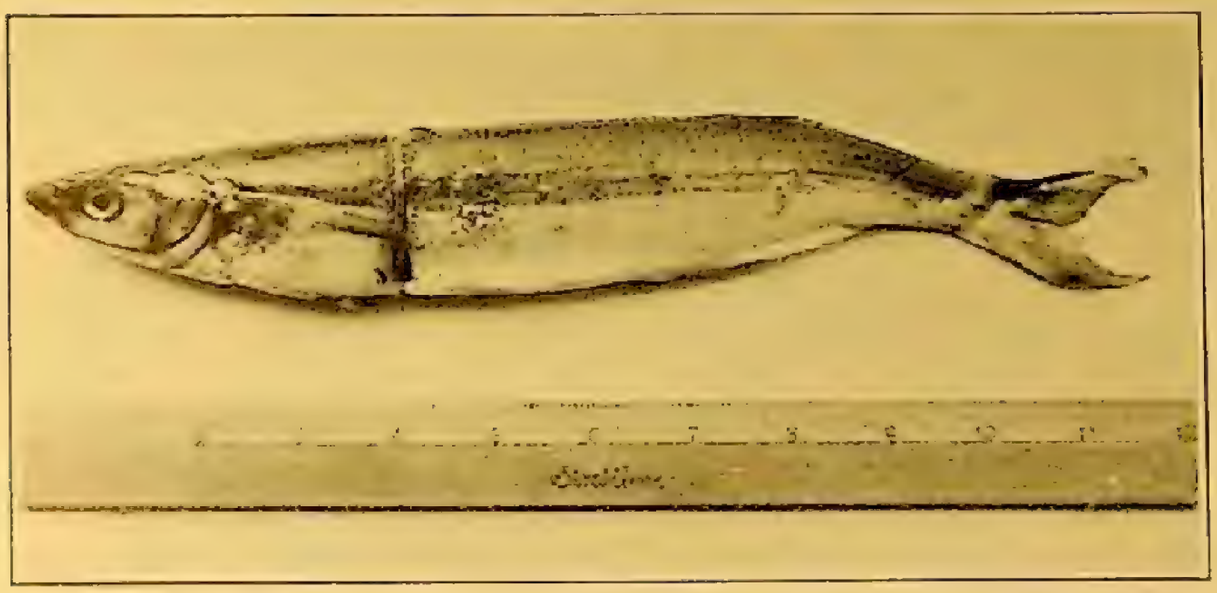

FIG. 23. Jack smelt encircled by rubber band, taken in Monterey Bay.

passed through the body cavity just below the alimentary canal. Europe has furnished similar records, Ehrenbaum (1912) reporting that banded mackerel have often been caught on the shores of France, Great Britain, Sweden and Germany.

There are two possible explanations as to how the the fishes come to acquire the bands. The first is that they were placed on the fishes by someone who hoped by the subsequent return of the specimens to learn something of their life history or habits. Although governmental bureaus engaged in life history investigations frequently use tagging or marking experiments, they have never resorted to anything so crude as unmarked rubber bands. If these bands have been placed on the fishes by human agency it is the work of unknown amateurs, but it is doubtful that the same idea and the same method of marking would occur to as many individuals scattered over as wide a territory as is indicated by the records.

The second and apparently the better explanation is that advanced by Gudger, who believes that young fishes feeding in harbors and on

refuse from passing ships may fortuitously thrust their heads through floating rubber bands and having thus acquired them, the fishes may wear the bands until they have grown up and the bands have become embedded in the body.

At first glance, this explanation may seem rather far-fetched, but Gudger's records of a swordfish landed at the Boston Fish Pier in 1926 with a rubber band around its sword, and of a 15-foot shark encircled by an automobile tire which was captured at Habana, Cuba, in 1930, hardly permit the postulation of a human agency and leave us with no other explanation.

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Gudger, E. W.

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Gudger, E. W., and Hoffmann, W. H.

1931. A shark encircled with a rubber automobile tire. Sci. Mon., vol. 33, pp. 275–277, 1 fig.

R. L. Bolin, Hopkins Marine Station.

THE FRIGATE MACKEREL

On November 6, 1935, the boat "Traveler II," while fishing between Catalina Island and the mainland, set its net around a school of fish thought to be mackerel. The fish were extremely fast and escaped before the net could be brought in. A few fish gilled in the wings, however, afforded a surprise to the crew: for they were not mackerel, but strangers to these waters and quite unknown by the fishermen. To settle the controversy that ensued, the crew brought to this laboratory for identification four specimens, which proved to be frigate mackerel.

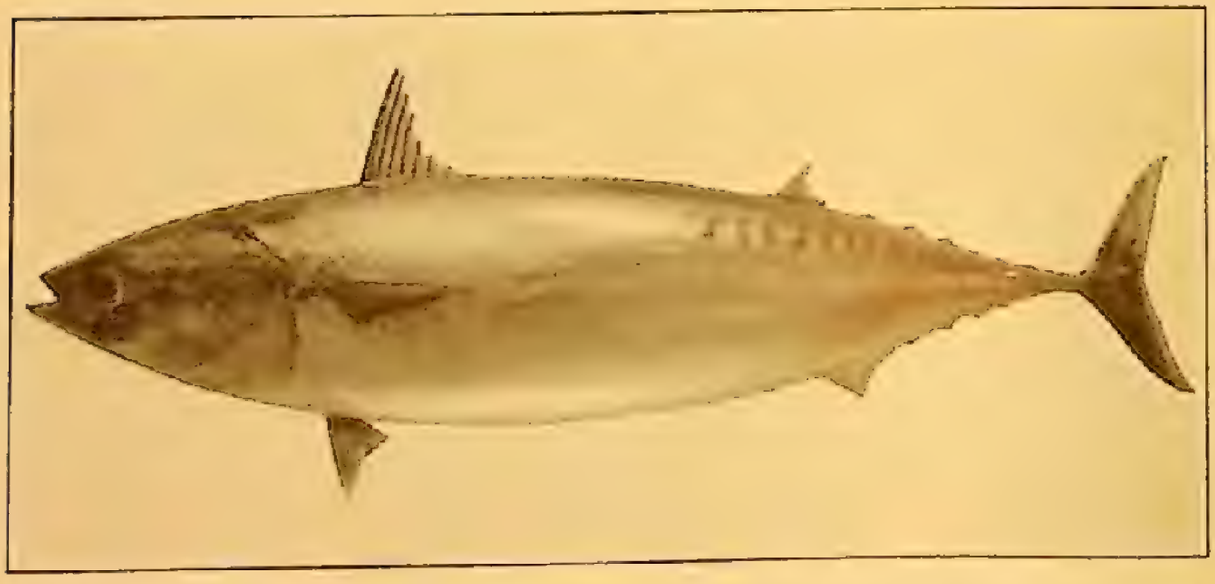

FIG. 24. The frigate mackerel (*Auxis* sp.). Photograph of a specimen (15 inches) taken locally with a few others, November 6, 1935. Photo by D. H. Fry, Jr.

These fish belong to the genus *Auxis*, and probably to the species *thazard*, the only species described from North American waters. The specimens taken here agree very closely with those from the Hawaiian Islands and described as *Auxis thazard* by Jordan and Evermann (1905), and show, moreover, a strong affinity in many characters with *Auxis maru*, described by Kishinouye (1923) from Japanese waters.

This graceful little tuna-like fish is an erratic visitor to our coast. It was reported in 1918, when the commercial boats fishing in the Catalina area caught a few. In August, 1919, it was taken in slightly greater quantity over a very few days in the latter half of that month. Apparently it has not been recorded since that time. It is, however, widely distributed in all warm seas, and is described by Jordan and Evermann as "abundant at Hilo * * * and is one of the best game fishes of the (Hawaiian) islands." It is therefore possible that our occasional visitors hail from the central Pacific.—*H. C. Godsil, California State Fisheries Laboratory, December 3, 1935.*

REPORTS

STATEMENT OF INCOME

For the Period July 1, 1935, to September 30, 1935, of the Eighty-seventh Fiscal Year

REVENUE FOR FISH AND GAME PRESERVATION FUND

	Detail	Total
Current year—		
License sales:		
Angling licenses, 1935	$83,399 00	
Commercial hunting club licenses, 1935-36	125 00	
Commercial hunting club operators' licenses, 1935-36	10 00	
Deer tags, 1935	23,753 00	
Fish breeders' licenses, 1935	25 00	
Fish importers' licenses, 1935	5 00	
Fish packers' and wholesale shell fish dealers' licenses, 1935-36	525 00	
Game breeders' licenses, 1935	105 00	
Hunting licenses, 1934-35	21,822 00	
Hunting licenses, 1935-36	55,151 00	
Market fishermen's licenses, 1935-36	22,730 00	
Trapping licenses, 1935-36	47 00	
Total license sales		$207,997 00
Other income:		
Court fines	$11,262 03	
Fish packers' tax	27,377 91	
Fish tag sales	902 59	
Game tag sales	48 00	
Importers' contributions	210 00	
Interest on bank balances	1,634 06	
Kelp tax	80 86	
Miscellaneous sales	472 21	
Publication sales	62 45	
Total other income		42,050 11
Grand total Fish and Game Preservation Fund		$250,047 11

STATEMENT OF EXPENDITURES

For the Period July 1, 1935, to September 30, 1935, of the Eighty-seventh Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Operating expenditures, eighty-seventh fiscal year					
Administration:					
Executive	$1,249 98				$1,249 98
Clerical and office	1,380 00	$373 22	$101 38	$56 93	1,911 53
Printing, general		157 33			157 33
Automobiles		84 46	48 25		132 71
Traveling			1,530 30		1,530 30
Postage			929 29		929 29
Telephone and telegraph			893 98		893 98
Freight, cartage and express			214 16		214 16
Rent			2,042 29		2,042 29
Accident and death claims			102 75		102 75
Departmental Administration pro rata	2,000 00		195 50		2,195 50
Federal cooperation	995 33				995 33
Total Administration	$5,625 31	$615 01	$6,057 90	$56 93	$12,355 15
Bureau Education and Research:					
Clerical and office	$480 00		$54 42	$25 00	$559 42
Automobiles		$27 15	66 88		94 03
Traveling			211 35		211 35
Photography			5 03		5 03
Library	330 00	140 99	7 00	102 70	580 69
Research	600 00	4 00		29 10	633 10
Publicity			27 14		27 14
State fair and other exhibits		113 48	1,272 45		1,385 93
Temporary help	40 50				40 50
Total Bureau Education and Research	$1,450 50	$285 62	$1,644 27	$156 80	$3,537 19
Bureau Patrol and Law Enforcement:					
Chief and assistants	$2,775 00				$2,775 00
Clerical and office	1,125 00	$13 01	$16 50		1,154 51
Automobiles		2,676 26	1,894 79	$8,190 97	12,762 02
Traveling			12,786 13		12,786 13
Postage			158 48		158 48
Telephone and telegraph			268 43		268 43
Freight, cartage and express			2 40		2 40
Rent			119 88		119 88
Captains and wardens	47,312 74	40 20	23 90		47,376 84
Launches		208 48	102 16		310 64
Fish planting	1,152 33	391 29	1,048 82		2,592 44
Premiums on bonds			282 50		282 50
Commercial fisheries patrol:					
Superintendent	690 00				690 00
Captains and wardens	3,030 00	52	31 50		3,062 02
Launches	2,849 51	1,185 44	1,448 61		5,483 56
Fish cannery inspectors, seasonal	1,130 43				1,130 43
Traveling			580 91		580 91
Rent			255 00		255 00
Automobiles		23 71	73 25		96 96
Temporary help	39 03				39 03
Total Bureau Patrol and Law Enforcement	$60,104 04	$4,538 01	$19,003 26	$8,190 97	$91,927 18
Bureau Commercial Fisheries:					
Chief and assistants	$3,263 68				$3,263 68
Clerical and office	2,400 00	$2 87	$0 76		$2,403 63
Automobiles		46 33	29 40		75 73
Traveling			1,744 40		1,744 40
Telephone and telegraph			158 69		158 69
Freight, cartage and express			31 76		31 76
Rent			32 60		32 60
Heat, light, water and power			65 51		65 51
Research	570 00	16 90	23 55		610 45
Laboratory	6,029 67	220 25	28 86	$52 39	6,331 17
Statistics		49 28	519 00		568 28
Temporary help	200 00				200 00
Terminal Island grounds			150 00		150 00
Total Bureau Commercial Fisheries	$12,463 35	$335 63	$2,784 53	$52 39	$15,635 90

STATEMENT OF EXPENDITURES

For the Period July 1, 1935, to September 30, 1935, of the Eighty-seventh Fiscal Year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Bureau Fish Culture:					
Chief and assistants	$1,815 00				$1,815 00
Clerical and office	1,664 33	$41 08	$2 25	$2 10	1,709 76
Automobiles		1,606 36	868 66	1,306 49	3,781 51
Traveling			3,107 91		3,107 91
Postage			50 40		50 40
Telephone and telegraph			315 95		315 95
Freight, cartage and express			127 00		127 00
Rent			1,414 00		1,414 00
Heat, light and power			396 27		396 27
Hatcheries	27,714 68	30,288 11	247 93	2,199 75	60,450 47
Fish cars	590 00	169 95	1,390 12		2,150 07
Blue printing			27 44		27 44
Cooperative research	40 65	250 00	147 15	4 85	442 65
Temporary help	655 92				655 92
Fish hatchery assistants, seasonal	10,005 27				10,005 27
Hydraulic engineering	600 00		204 66		804 66
Special field	2,790 00				2,790 00
Fish rescue	495 16	242 45	681 70		1,419 31
Total Bureau Fish Culture	$46,371 01	$32,597 95	$8,981 50	$3,513 19	$91,463 65
Bureau Game Propagation:					
Chief and assistants	$1,185 00				$1,185 00
Clerical and office	210 00				210 00
Automobiles		$162 46	$18 50		180 96
Traveling			638 25		638 25
Postage			2 03		2 03
Telephone and telegraph			28 61		28 61
Freight, cartage and express			2 45		2 45
Heat, light, water and power			566 70		566 70
Maintenance	3,424 08	2,179 32	32 59	$9 66	5,645 65
Temporary help	414 03				414 03
Quail trapping and expansion of quail program	1,155 00	106 46	259 37		1,520 83
Total Bureau Game Propagation	$6,388 11	$2,448 24	$1,548 50	$9 66	$10,394 51
Bureau Game Refuges:					
Chief and assistants	$1,791 66				$1,791 66
Clerical and office	480 00	$0 52		$95 94	576 46
Automobiles		41 55	$23 61	21 45	86 61
Traveling			1,119 03		1,119 03
Refuge posting	36 29				36 29
Temporary help, seasonal	621 00				621 00
Refuge maintenance	1,559 35	476 56	1,433 06	8 17	3,477 14
Statistics	188 21	826 67	88	717 14	1,732 90
Total Bureau Game Refuges	$4,676 51	$1,345 30	$2,576 58	$842 70	9,441 09
Bureau Licenses:					
Clerical and office	$3,199 51	$73 84	$13 30	$71 14	$3,357 79
Printing, licenses and applications		67 90			67 90
Traveling			213 01		213 01
Postage			417 15		417 15
Freight, cartage and express			47 55		47 55
Premiums on bonds			987 50		987 50
Temporary help	170 32				170 32
License commissions			11,956 35		11,956 35
Total Bureau licenses	$3,369 83	$141 74	$13,634 86	$71 14	$17,217 57
Total 87th fiscal year expenses paid from Support appropriations	$140,448 06	$42,308 40	$56,321 40	$12,893 78	$251,972 24
Special items:					
Predatory Animal Control:					
Lion hunters	$1,143 34		$1,350 00		$2,523 34
Predatory animal hunters and trappers, seasonal	1,500 00				1,500 00
Total Predatory Animal Control	$2,643 34		$1,380 00		$4,023 34
Total operating expenditures, 87th fiscal year	$143,092 00	$42,308 40	$57,701 40	$12,893 78	$255,995 58
Contributions to Employees' Retirement System					1,439 64
Total expenditures, 87th fiscal year from current biennium					$257,435 22

STATEMENT OF EXPENDITURES

For the Period July 1, 1935, to September 30, 1935, of the Eighty-seventh Fiscal Year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Prior biennium appropriations:					
87th fiscal year:					
Operating expenditures:					
Special Items:					
California Code Commission expenses —Chap. 645-33				$609 07	
Construction Russian River Jetties—Chap. 989-33				60 00	
Total Operating Expenditures					$669 07
Expenditures for additions and betterments:					
Construction, improvements and equipment—Chap. 278-33	$89 00	$686 35	$20 05		795 40
86th fiscal year:					
Operating expenditures:					
Support				$10,170 71	
Fresh fish marketing				148 79	
Special item—License Commission				296 50	
Total Operating Expenditures					10,616 00
Expenditures for additions and betterments:					
Construction, improvements and equipment—Chap. 278-33					500 00
85th fiscal year:					
Operating expenditures:					
Special item—Claim of Chief Accounting Officer of Dept. of Finance—Chap. 991-33					35 50
Total Prior Biennium Appropriations					$12,545 57
Grand total proprietary group					$269,980 79

SEIZURES OF FISH AND GAME

July, August, September, 1935

Game:	
Deer	23
Deer hides	2
Deer meat, pounds	2,372
Doves	896
Ducks	10
Egret	2
Larks, horned	3
Pheasant	15
Quail	39
Rabbits	23
Shorebirds	1
Box of quail feathers	1
Hunting license	1
Deer tags	2
Fish:	
Abalone	30
Abalone, pounds	50
Barracuda	3
Barracuda, pounds	914
Bass—	
Black	60
Striped	292
Striped, pounds	14
Clams	2,180
Crappie, perch, sunfish	359
Lobster	665
Lobster, pounds	75
Lobster receivers	2
Lobster traps	128
Salmon	1
Trout	515
Trout, pounds	70
Skeins of fresh trout roe	

FISH CASES

July, August, September, 1935

Offense	Number arrests	Fines imposed	Jail sentences (days)
Abalones; undersize	2	$125 00	----------
Angling; no license; illegal license	58	572 50	42
Barracuda; selling in closed season	3	80 00	----------
Bass, black; striped; undersize; overlimit; closed season; selling	53	959 00	42
Clams; overlimit; undersize; possession of fork	74	892 50	245
Commercial fishing; no license	24	200 00	----------
Crabs; undersize; female	2	35 00	----------
Crappie; perch; sunfish; overlimit	8	165 00	----------
Fishing in fishway; closed stream	4	37 50	1
Lobsters; undersize	3	20 00	12½
Net; illegal	54	2,145 00	50
Night fishing	27	305 00	----------
Salmon; overlimit; spearing	7	10 00	----------
Trout; overlimit; closed waters; closed season; set line	20	481 00	----------
Yellowtail; canning; selling local	2	----------	----------
Miscellaneous fish cases	11	40 00	25
Totals	352	$6,107 50	417½

GAME CASES

July, August, September, 1935

Offense	Number arrests	Fines imposed	Jail sentences (days)
Deer; closed season; possession doe, fawn, spike buck; killing spike buck, doe; closed district	108	$2,226 50	827½
Deer tags; mutilation; failure to fill out; false entries; failure to attach	33	450 00	180
Doves; closed season; overlimit	39	930 00	100
Ducks; closed season	3	125 00	----------
Firearms; illegal possession of	32	350 00	25
Hunting; no license; night hunting; posted lands	87	1,040 00	262½
License; transfer of	3	55 00	----------
Non-game birds; possession of	2	75 00	----------
Pheasants; closed season	10	250 00	----------
Pollution	1	100 00	----------
Quail; closed season	11	585 00	----------
Rabbits; closed season	7	85 00	----------
Sagehen; possession of	1	25 00	----------
Shooting from highway	8	50 00	----------
Shorebirds; shooting of	2	105 00	----------
Spotlight hunting	20	180 00	182
Miscellaneous game cases	9	60 00	250
Totals	378	$6,721 50	1,827

FRESH FISH IMPORTATIONS BY POINT OF ORIGIN* FOR JULY, AUGUST AND SEPTEMBER, 1935

Compiled by the Division of Fish and Game, Bureau of Research and Engineering

Species	Gulf of California	West Coast Lower California	International waters south U. S. boundary (definite origin unknown)	Mexican mainland, Central and South America	Japan	Total pounds
Barracuda		295,330				295,330
Cabrilla	1,652	4,588				6,240
Grouper		3,977				3,977
Halibut, California		235,730				235,730
Kingfish		113				113
Mackerel, Pacific		923,821				923,821
Mackerel, Spanish		445				445
Perch		3,027				3,027
Rock Bass		12,984				12,984
Rockfish		42,017				42,017
Sablefish		4,304				4,304
Sardine		695				695
Sea-bass, Black		68,848				68,848
Sea-bass, White		395,305				395,305
Shark		5,499				5,499
Sheepshead		31				31
Skate		2,330				2,330
Smelt		271				271
Swordfish, Broadbill		46,836				46,836
Swordfish, Marlin		644				644
Tuna, Albacore		60,579			590,799	651,378
Tuna, Bluefin		2,053,223				2,053,223
Tuna, Bonito		4,143,114				4,143,114
Tuna, Oriental					25,454	25,454
Tuna, Skipjack	230,711	1,265,163	5,223,080		19,791	6,739,645
Tuna, Yellowfin	290,149	1,526,752	16,054,428	208,575		18,079,904
Whitefish		865				865
Yellowtail		3,512,983	16,131			3,529,114
Miscellaneous fish		698				698
Crustacean:						
Lobster, Spiny		43,725				43,725
Mollusk:						
Clam, Pismo		800				800
Reptile:						
Turtle		1,722				1,722
Total pounds	522,512	14,656,395	21,294,539	208,575	636,044	37,318,095

*These importations are included in tables of landings. They include fish caught by California boats in foreign waters as well as frozen fish imported for canning in California plants.

FRESH FISH IMPORTATIONS* FROM FOREIGN COUNTRIES FOR JULY, AUGUST AND SEPTEMBER, 1935

Compiled by the Division of Fish and Game, Bureau of Research and Engineering

Species	Landed in Region 70, Los Angeles	Landed in Region 80, San Diego	Total pounds
Barracuda	34,508	200,828	205,336
Cabrilla	1,749	4,491	6,240
Grouper		3,977	3,977
Halibut, California	64,478	171,252	235,730
Kingfish		113	113
Mackerel, Pacific		923,821	923,821
Mackerel, Spanish	295	150	445
Perch		3,027	3,027
Rock Bass	1,369	11,615	12,984
Rockfish		42,017	42,017
Sablefish		4,304	4,304
Sardine		695	695
Sea-bass, Black	40,850	27,989	68,848
Sea-bass, White	217,430	177,875	395,305
Shark		5,499	5,499
Sheepshead		31	31
Skate		2,330	2,330
Smelt		271	271
Swordfish, Broadbill	9,903	36,933	46,836
Swordfish, Marlin	510	134	644
Tuna, Albacore	590,885	60,493	651,378
Tuna, Bluefin	1,278,844	774,379	2,053,223
Tuna, Bonito	3,691,066	452,048	4,143,114
Tuna, Oriental	25,454		25,454
Tuna, Skipjack	1,506,139	5,233,506	6,739,645
Tuna, Yellowfin	4,535,594	13,544,310	18,079,904
Whitefish		865	865
Yellowtail	1,125,961	2,403,153	3,529,114
Miscellaneous fish	698		698
Crustacean:			
Lobster, Spiny		43,725	43,725
Mollusk:			
Clam, Pismo		800	800
Reptile:			
Turtle		1,722	1,722
Total pounds	13,125,742	24,192,353	37,318,095

*These importations are included in tables of landings. They include fish caught by California boats in foreign waters as well as frozen fish imported for canning in California plants.

FRESH FISH TAKEN IN WATERS NORTH OF THE STATE LINE BY REGISTERED CALIFORNIA FISHING BOATS*

(Landed in Region 70, Los Angeles)

Species	September, 1935
Cultus, Pacific	703
Halibut, Northern	1,357
Rockfish	1,812
Sablefish	8,771
Shark	200
Total pounds	12,843

*The California commercial fishing boats have fished north of the State line in the past, landing the catch in California ports but we have had no means of separating the amounts so taken. A new type of fish receipt provides a place to indicate where the fish were caught and in the future this record should be more complete. G. Conner.

CALIFORNIA FRESH FISH LANDINGS* FOR JULY, AUGUST AND SEPTEMBER, 1935

Compiled by the Division of Fish and Game, Bureau of Research and Engineering

Species	Region 10, Del Norte	Region 20, Eureka	Region 30, Sacramento	Region 40, San Francisco	Region 50, Monterey	Region 60, Santa Barbara	Region 70, Los Angeles	Region 80, San Diego	Total pounds
Anchovy				52,400	64,815		2,990		120,205
Barracuda						16,143	971,707	283,472	1,271,322
Cabezone					5,643				5,643
Cabrilla							1,749	4,491	6,240
Carp			6,520				20,455		26,975
Catfish			58,493						58,493
Cultus, Pacific	5,542	77,964		220,486	24,167	60	703		328,922
Eel				5					5
Flounder, Starry				47,721	2,280	10			50,020
Flying Fish							18,106		18,106
Grouper								3,977	3,977
Hake				7,215			43		7,258
Halibut, California				5,975	9,696	66,478	90,466	171,490	344,045
Halibut, Northern	2,140	315,308		25,843			1,357		344,657
Hardhead			1,443						1,443
Herring, Pacific		4,405			19,200				23,605
Kingfish				8,077	36,832		101,286	372	147,167
Mackerel, Horse					98,960		4,022,951		4,121,911
Mackerel, Pacific		7		4,460	2,355,736	12,757	33,626,948	2,213,050	38,212,958
Mackerel, Spanish							295	150	445
Mullet							120	4,788	4,908
Perch				32,704	7,408	846	25,683	3,380	70,081
Pike			54						54
Pompano, California					37		3,349		3,386
Rock Bass						1,689	68,425	69,912	140,026
Rockfish	3,042	47,537		201,807	501,733	119,189	84,983	54,297	1,102,978
Sablefish	303	539,096		170,322	196,824	1,930	21,608	4,783	934,956
Salmon	204,061	2,778,891	759,870	1,041,202	31,888				4,815,921
Sand Dab				138,662	15,023		1,704		155,389
Sardine			17,332,300	4,080,825	76,588,817	409	19,660	695	98,622,706
Sculpin							18,590	329	18,919
Sea-bass, Black					12	1,368	44,131	28,948	74,459
Sea-bass, Short-fin								215	215
Sea-bass, White				381	840	33,424	415,162	214,609	664,416
Shark				8,362		6,970	57,139	35,726	108,197
Sheepshead						4,987	5,107	575	10,669
Skate				26,338	5,612	2,537	287	5,178	39,952
Smelt	238	6,425		74,538	99,869	5,240	53,570	2,401	242,281
Sole	55	7		1,928,976	12,669	145,192	409		2,087,308
Split-tail			1,704						1,704
Sucker			1,100						1,100
Swordfish, Broadbill						19,285	343,640	182,906	545,831

Swordfish, Marlin							13,570	3,988	17,567
Tuna, Albacore		19			340,917	363	1,581,321	237,521	2,166,141
Tuna, Bluefin							8,250,033	1,014,125	9,273,158
Tuna, Bonito						120	3,975,626	685,449	4,661,195
Tuna, Oriental							25,454		25,454
Tuna, Skipjack							1,564,842	6,582,348	8,147,190
Tuna, Yellowfin							4,576,301	13,969,124	18,545,425
Turbot				10,994		8	228		10,330
Whitebait	1,130	19,633		1,965	1,741				24,469
Whitefish						689	4,024	1,420	6,033
Yellowtail							1,170,190	2,416,027	3,586,217
Miscellaneous Fish		5,911	600	51,911	122	16	1,147		59,707
Crustacean:									
Crab	1,400	46,150		157,712	182				207,450
Crab, Rock							1,025		1,025
Lobster, Spiny						27,020	46,501	70,522	146,043
Prawn					270				270
Shrimp				1,841,763					1,841,763
Mollusk:									
Abalone				10,825	1,248,750	494,825	208		1,754,608
Clam, unclassified	34						16		50
Clam, Cockle		369		8,050			5,237		13,692
Clam, Gaper				648					648
Clam, Pismo					4,137	51,542		800	56,479
Clam, Razor	40								40
Clam, Soft-shell				41,483					41,483
Clam, Washington		7,102		606					7,708
Mussel							10		10
Octopus				6,581	18,664				25,245
Oyster, Eastern				55,842					55,842
Oyster, Japanese				53,915	28,480				82,395
Oyster, Native				12,612	2,490				15,102
Squid					87,148		7,512		94,660
Reptile:									
Turtle								1,722	1,722
Total pounds	218,084	3,851,130	18,162,093	11,021,060	81,816,971	1,013,897	61,257,717	28,268,700	205,609,742

*Importations of fresh fish from foreign countries included. See importation tables.

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_____ Sergeant ..... Indio
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LAUNCH PATROL

Motor Vessel "Bluefin," Terminal Island
Launch "Albacore,' Monterey
Launch "Shrapnel," Sacramento
Launch "Hunter," Vallejo
Launch "Rainbow," Walnut Grove
Launch "Silverside," Eureka
Launch "Quinnat III," San Francisco
Launch "Broadbill," Newport Harbor

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